FOUNDRY TRADE JOURNAL

EST. 1902

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MAY 5, 1960
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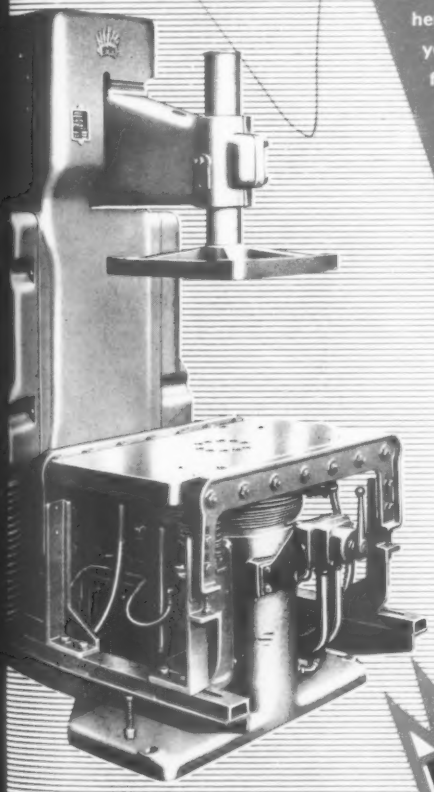

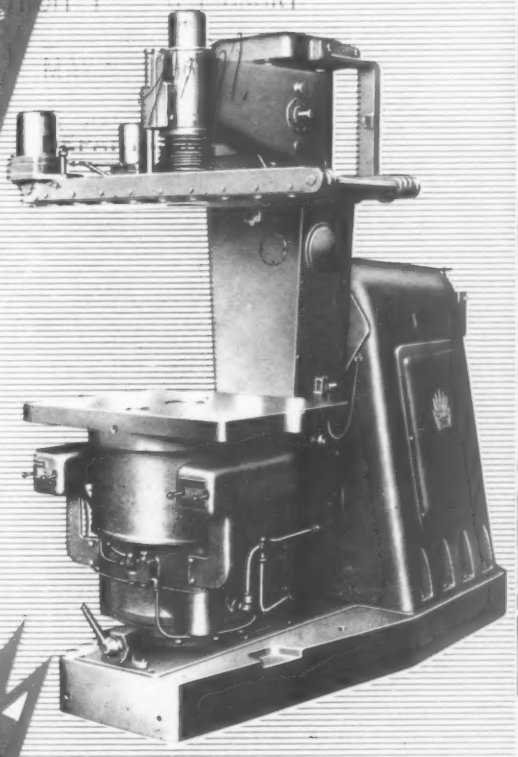

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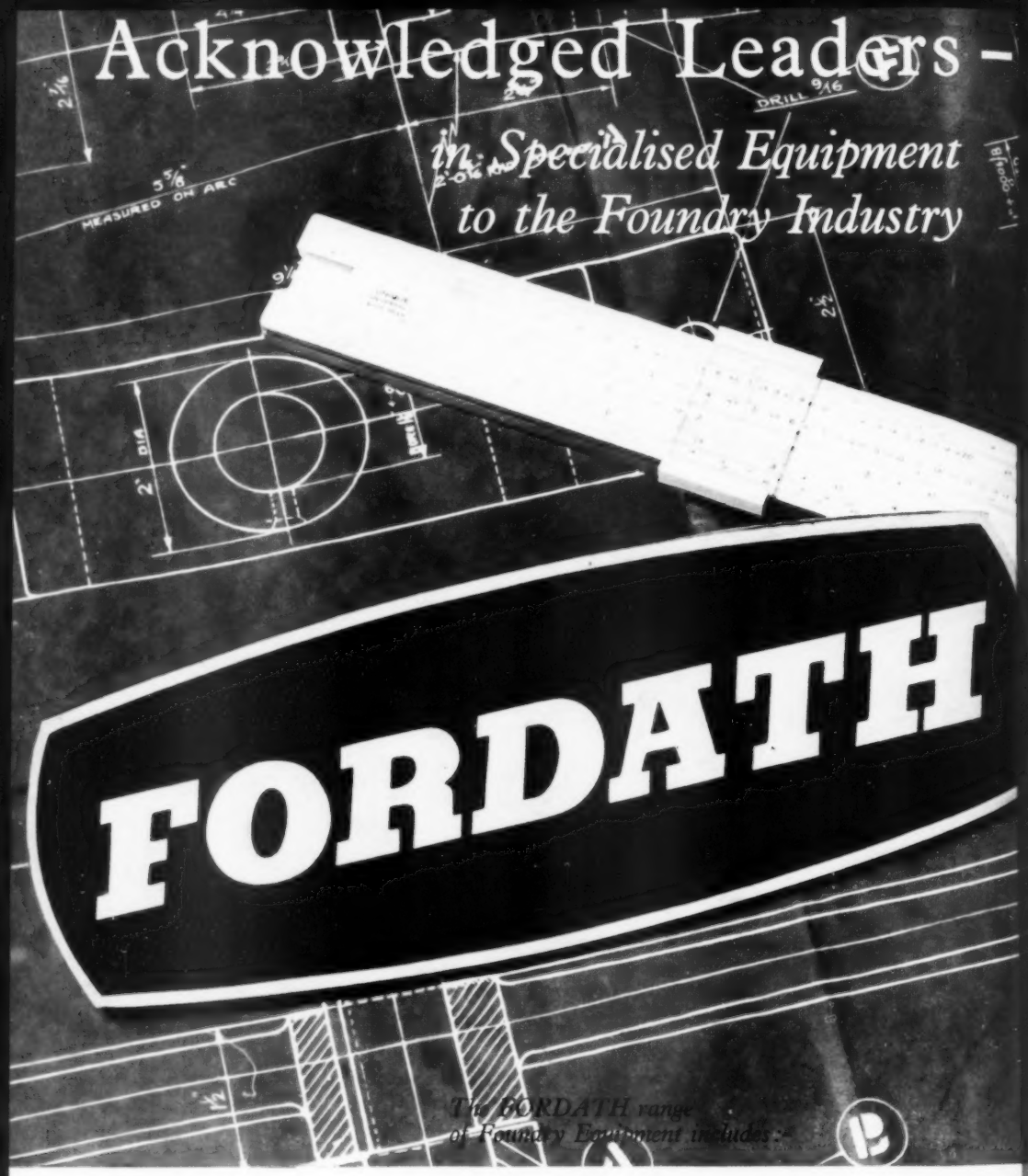

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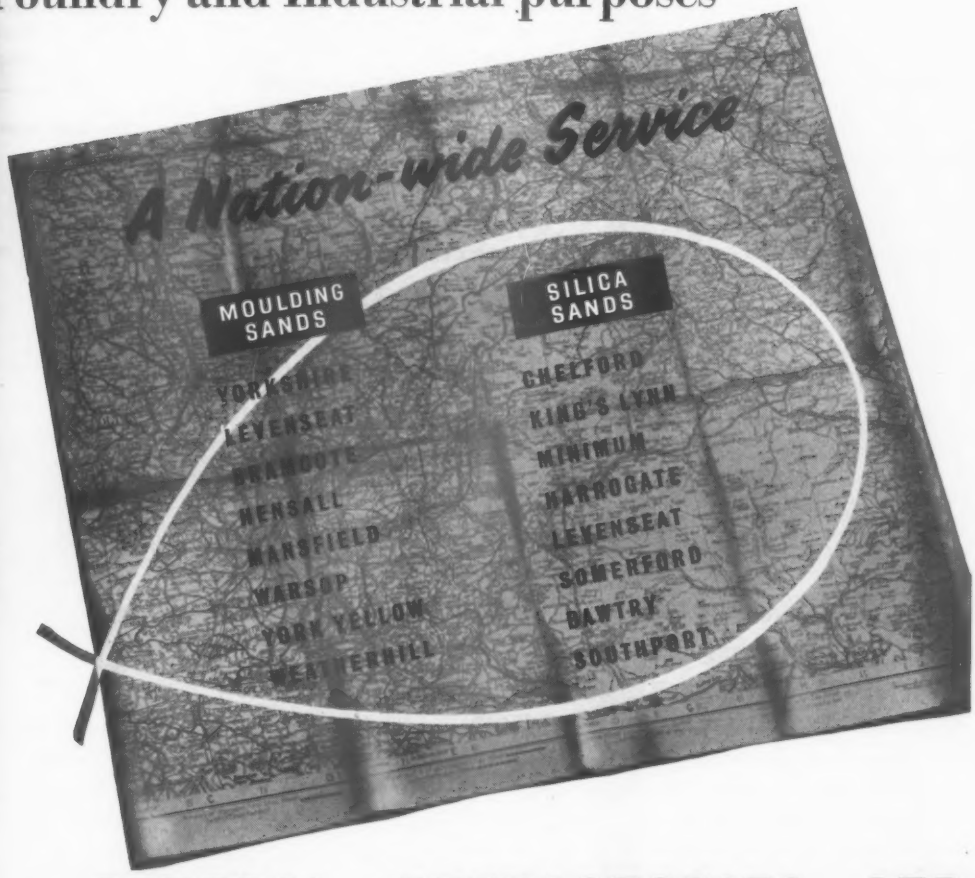

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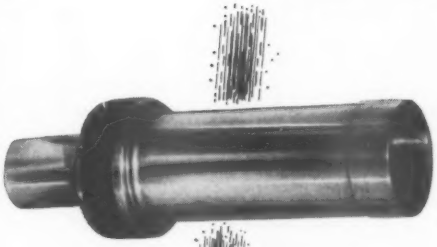

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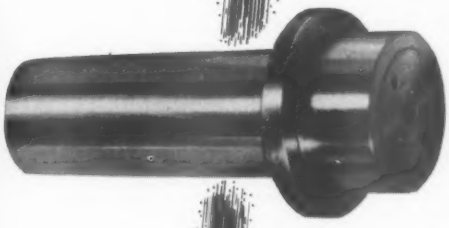

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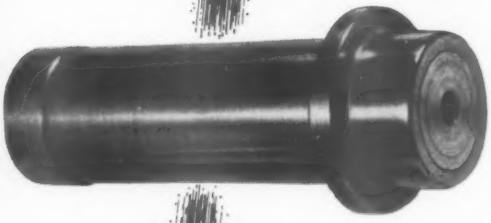

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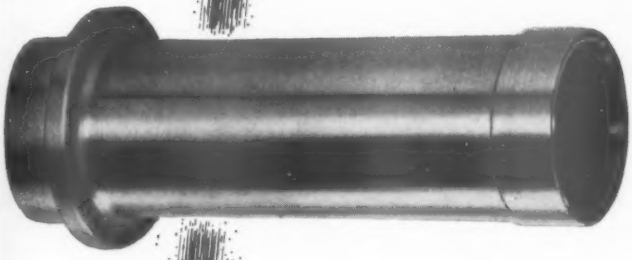

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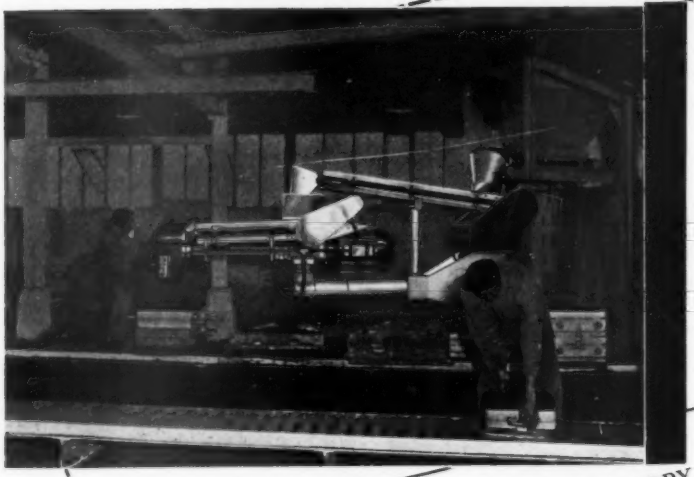

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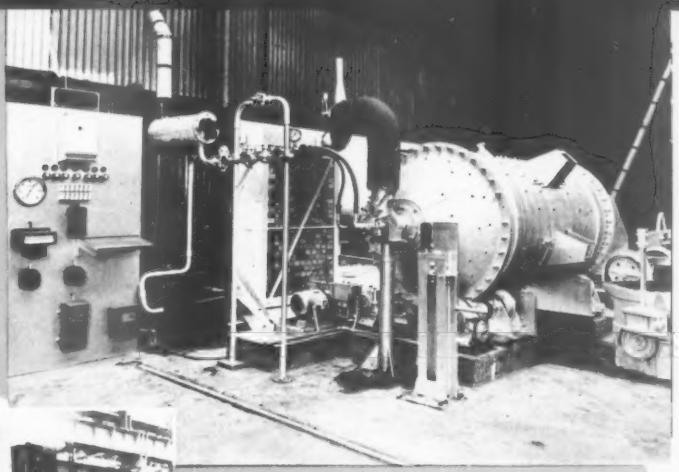

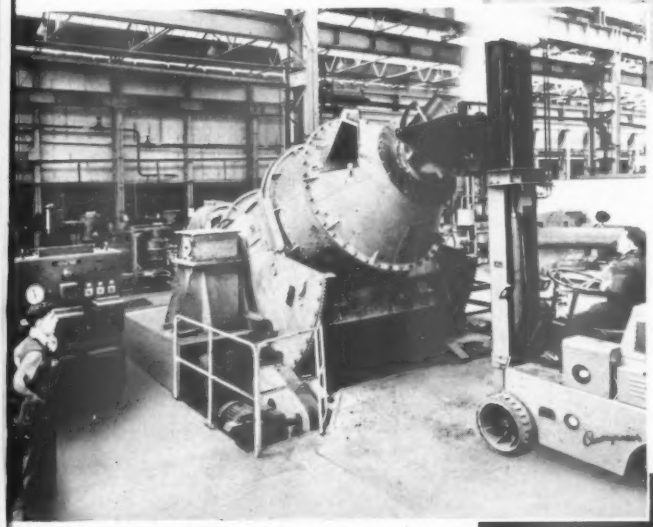

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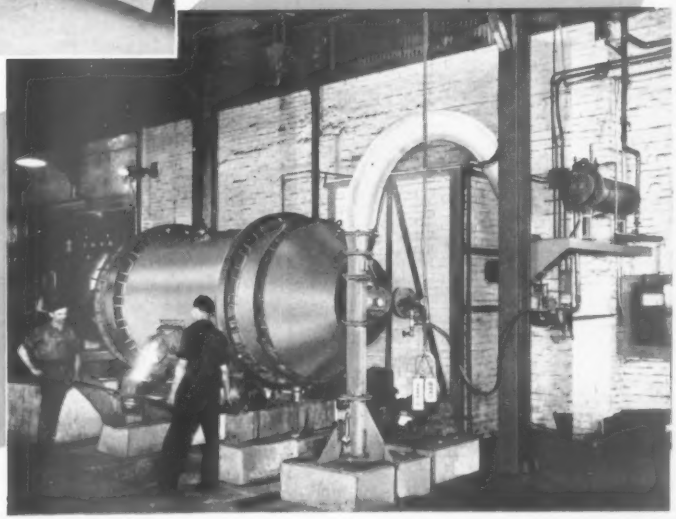

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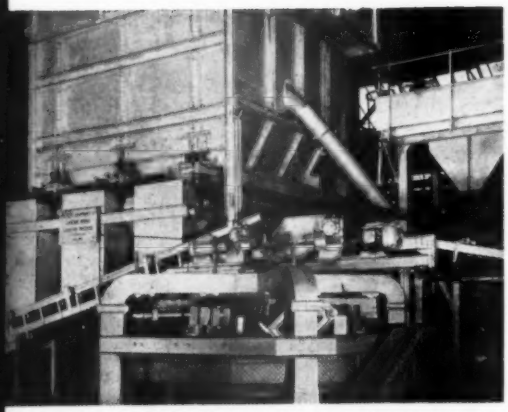

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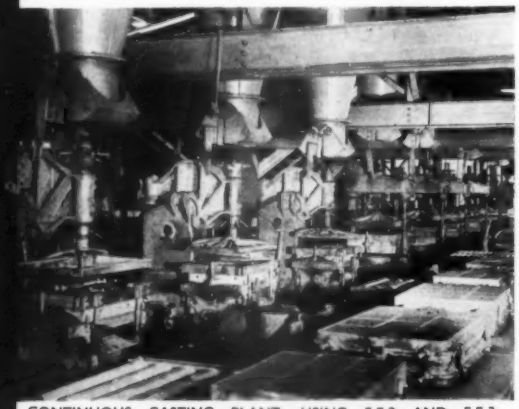

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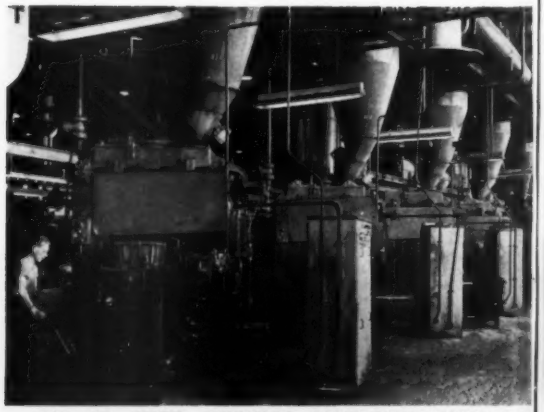

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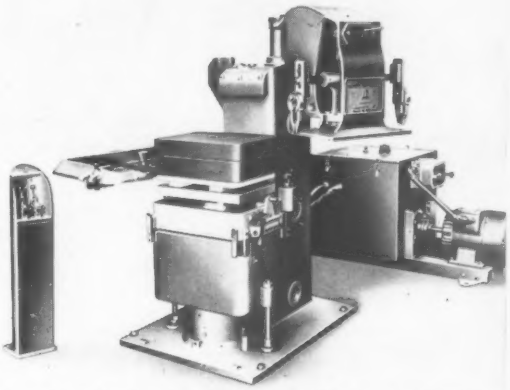

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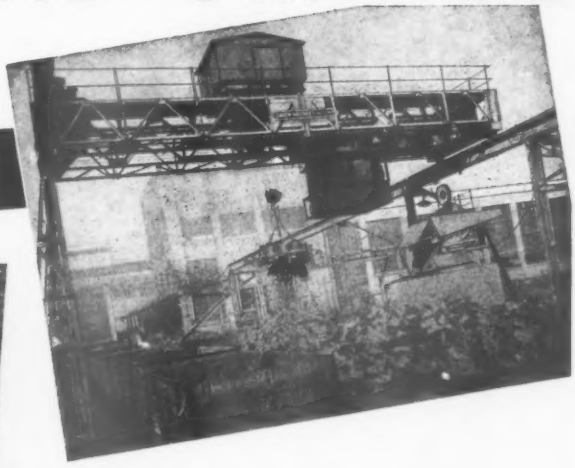

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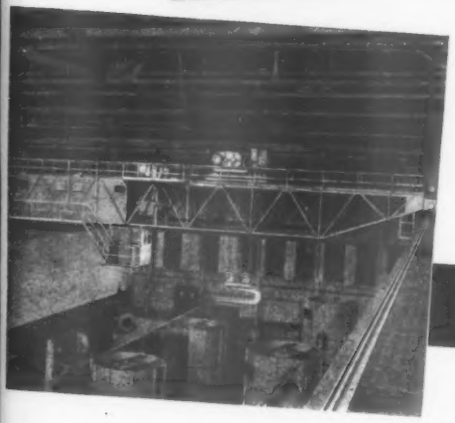

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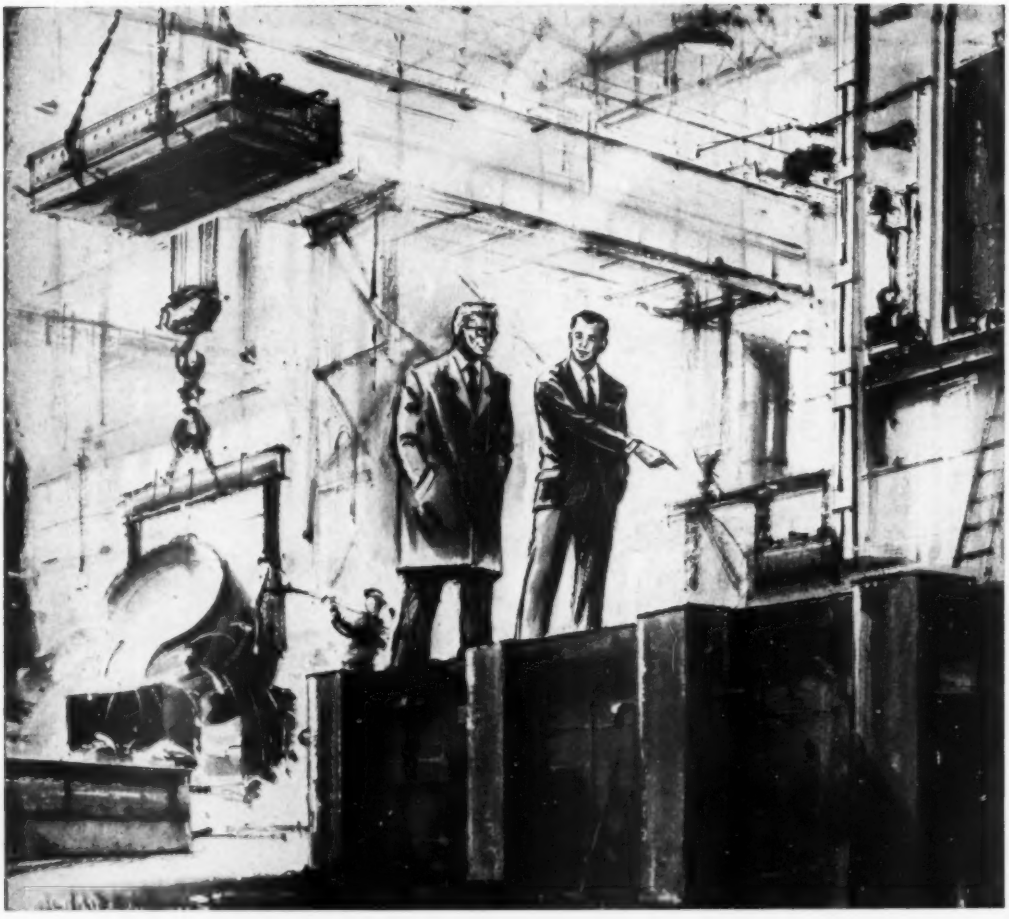

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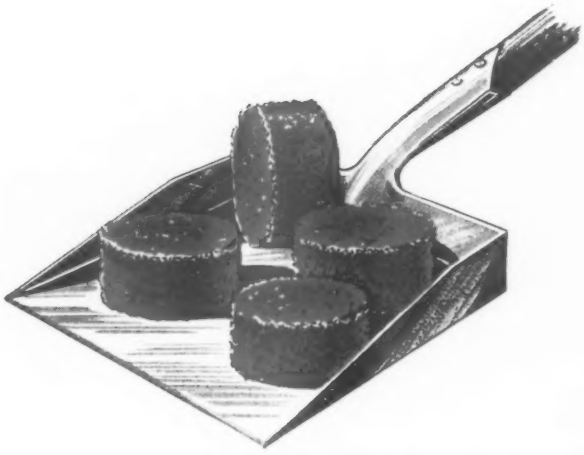

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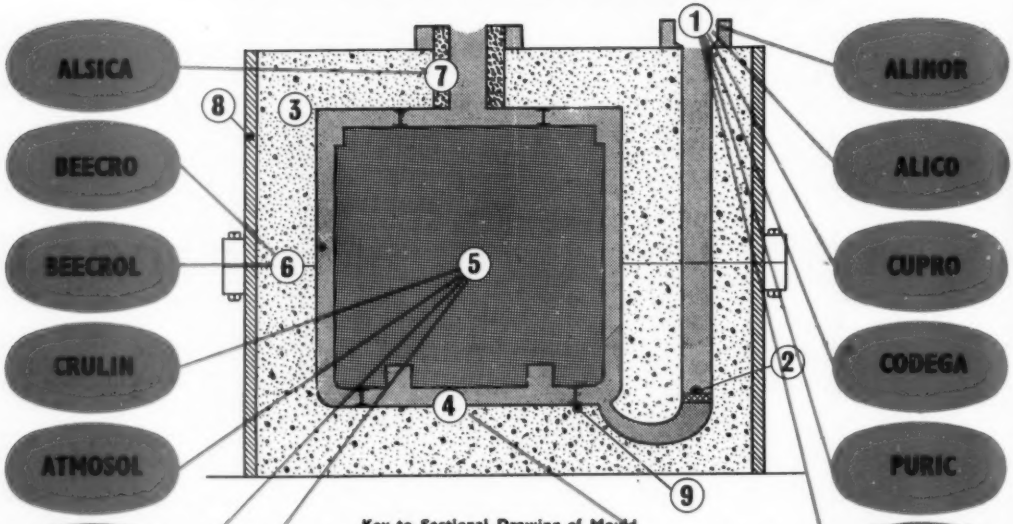

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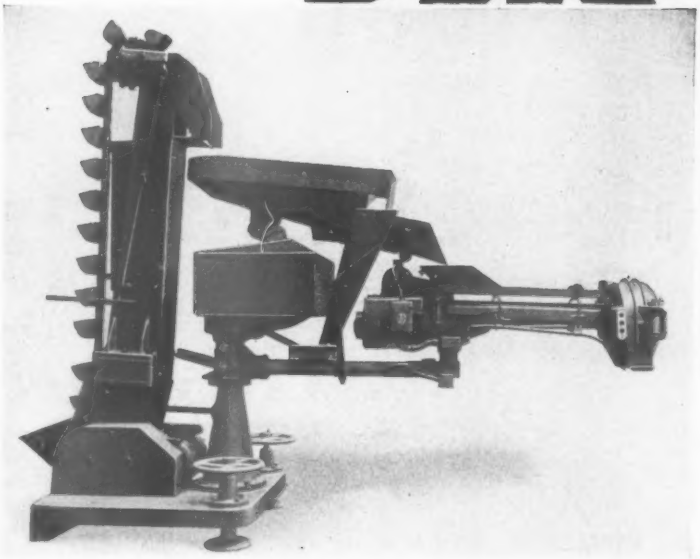

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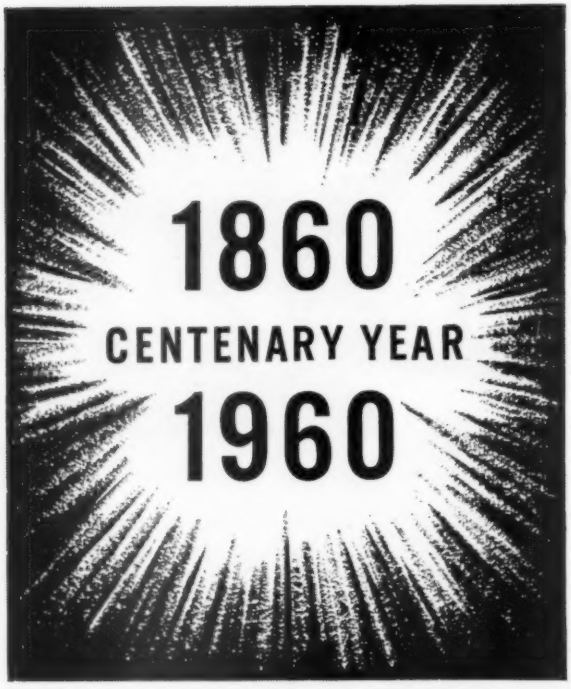

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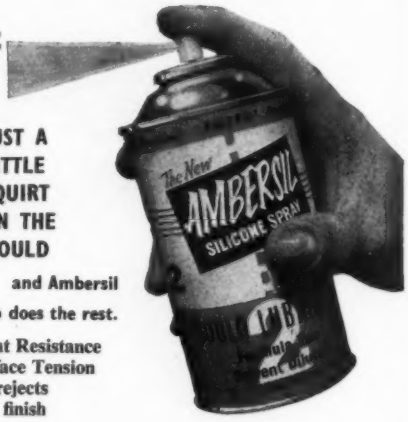

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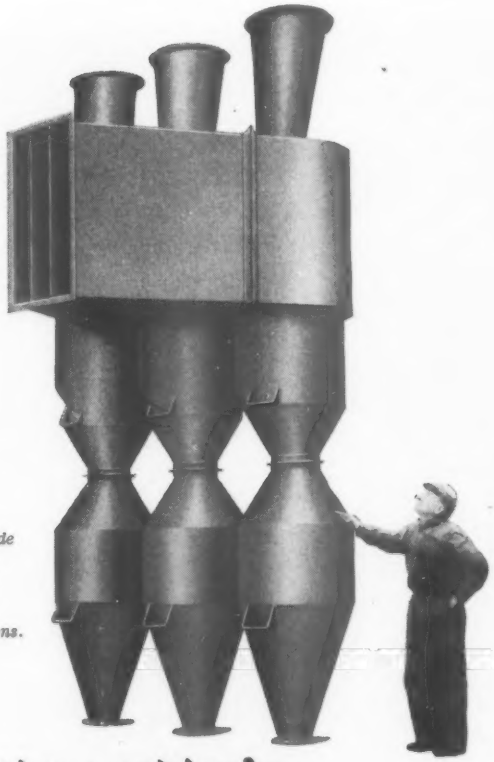

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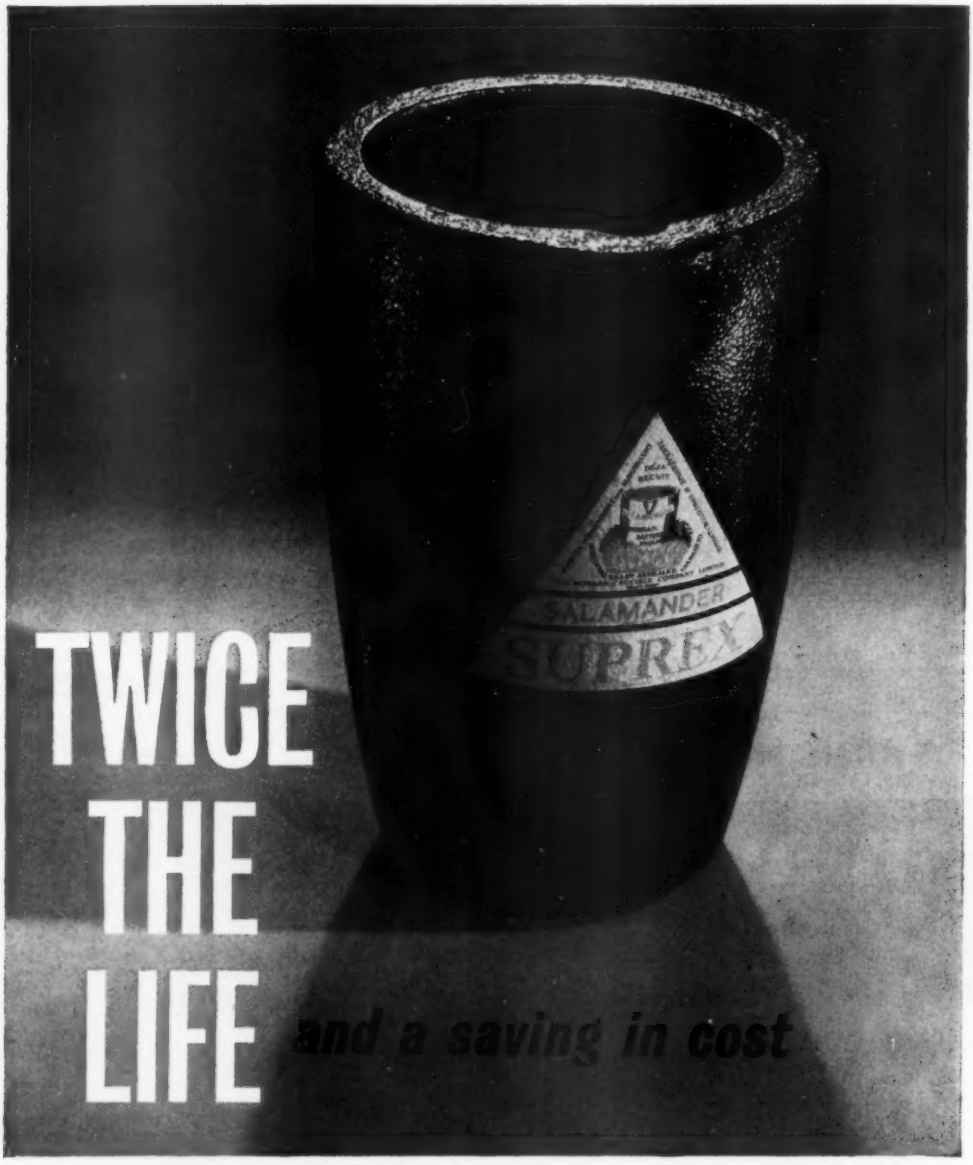

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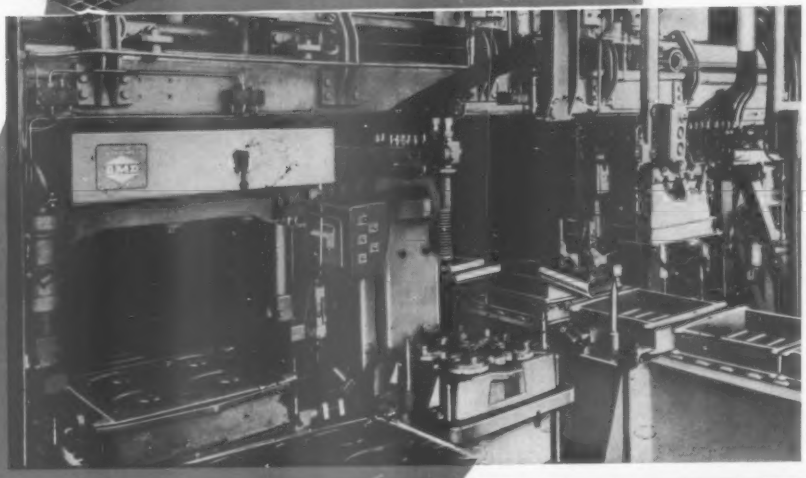

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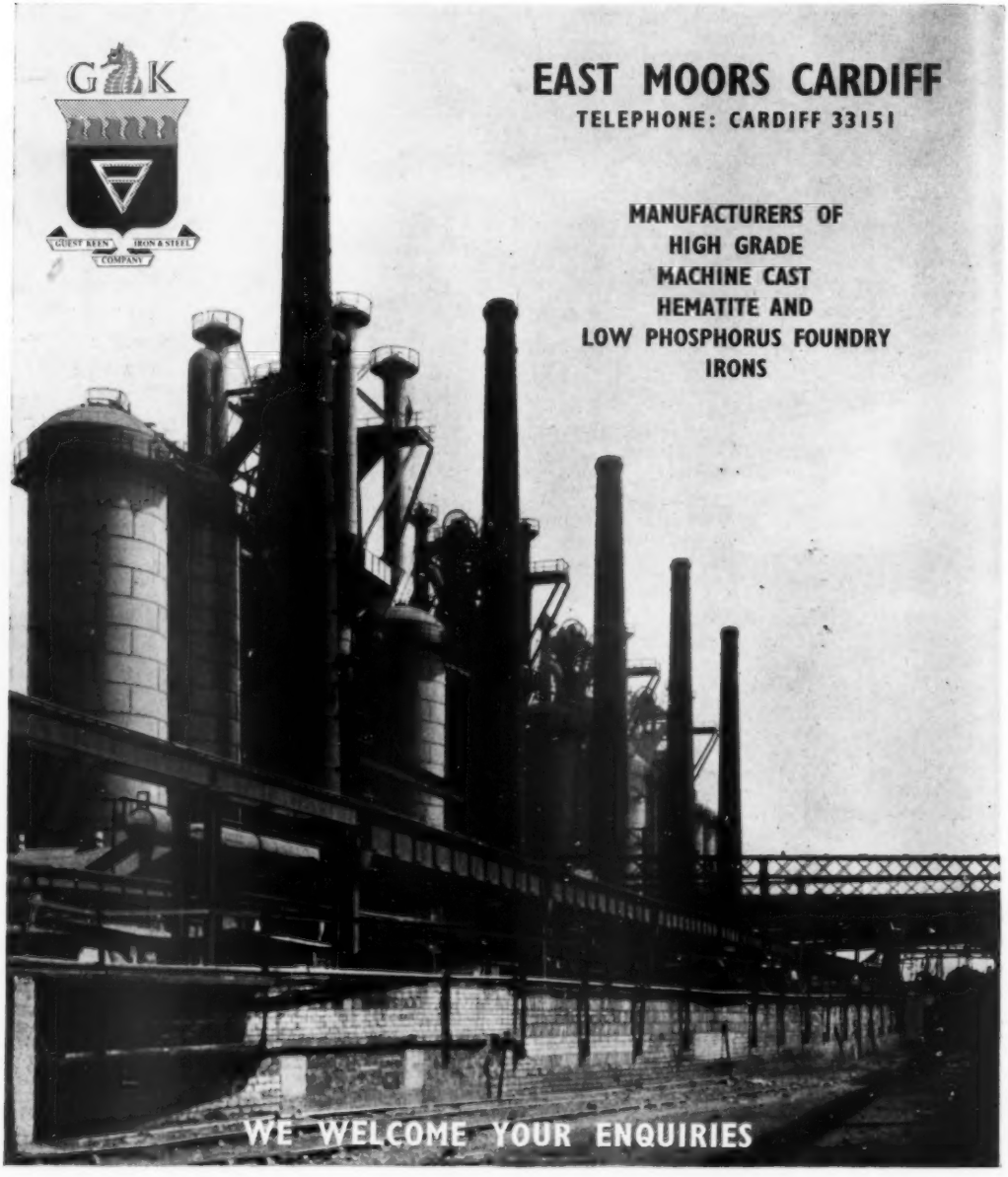

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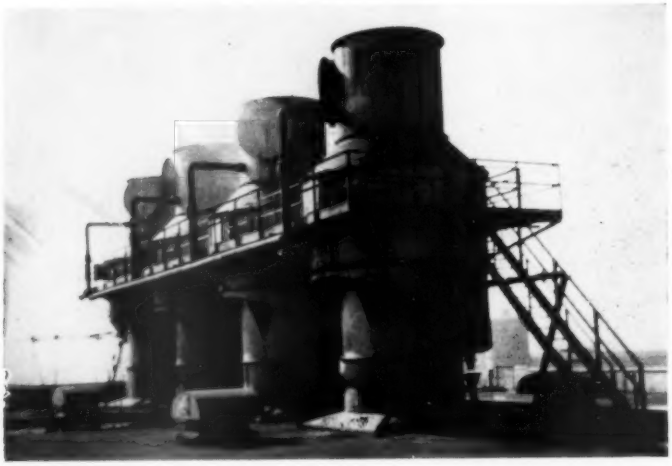

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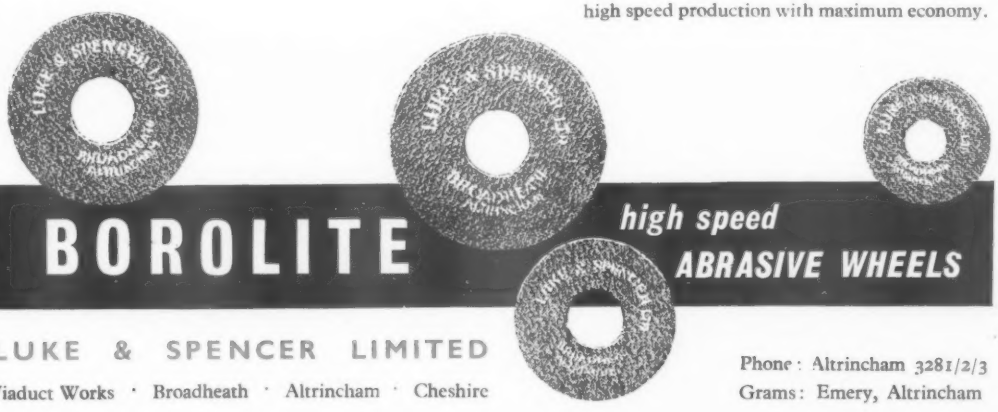

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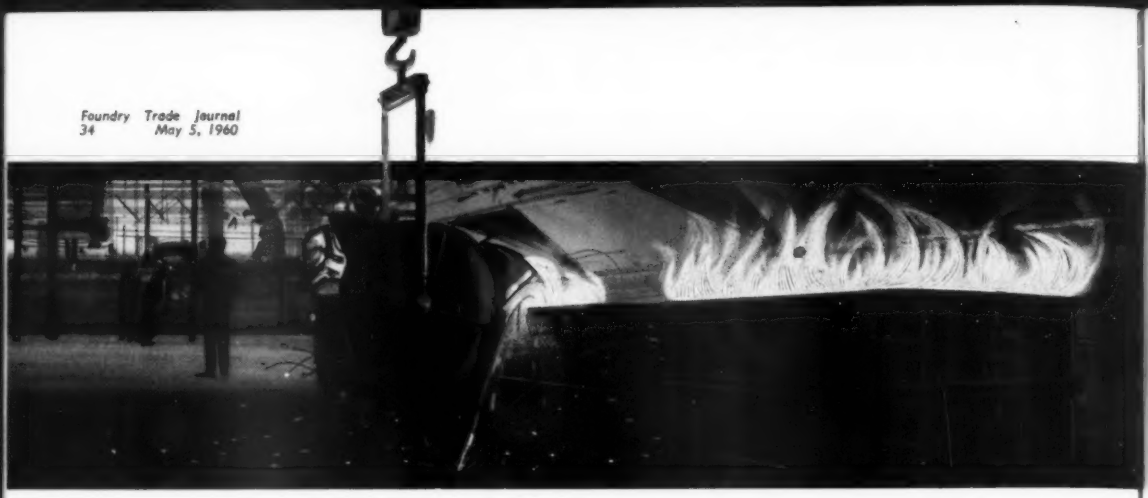

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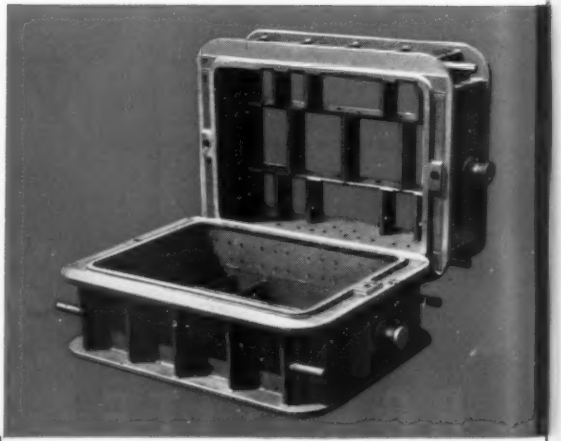

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Vol. 108 May 5, 1960 No. 2265

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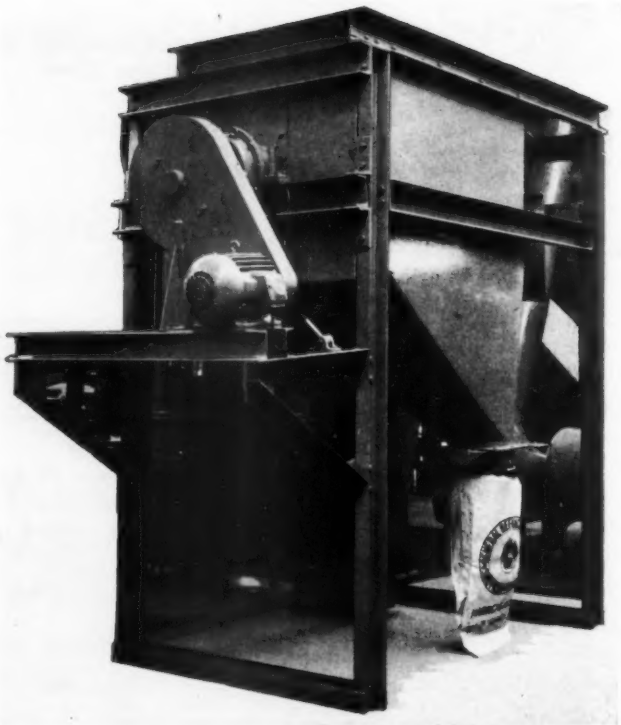

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FOUNDRY
TRADE JOURNAL

Vol. 108 May 5, 1960 No. 2265

Welding Grey-iron Castings

The science and art of welding has long become accepted by engineers as a reliable means of construction and also as a method for the reclamation of imperfect steel castings. Many years ago, a paper was presented by Mr. V. C. Faulkner to an international welding congress describing the methods used by a large automobile manufacturing concern for the reclamation of slightly-defective grey-iron motor-car castings. A well-known house-magazine issued by a welding-rod maker usually carries descriptions of the repair of iron castings broken in service. In fact, the processes for the welding of iron castings are now well documented and widely appreciated.

It would be of great service to ironfounders if engineers would accept the welding of iron castings as a normal process to be used if necessary in their manufacture. But first they must be assured that they receive a properly engineered component on which any weld reclamation has been carried out by expert craftsmen, exactly as is done in the steel foundry. It must also be realised that an iron casting welded by an amateur would most probably be much worse and not better for the treatment. The larger ironfoundry establishments could quite profitably organise a well-run welding department, open to customers' inspection and operated under metallurgical supervision, where the enhanced appearance and usefulness of a casting after welding could be guaranteed.

Cases exist where a buyer of iron castings has such confidence in his supplier that he permits the reclamation of slightly-defective components to their mutual benefit. This laudable system can only be extended if ironfounders instal, under competent supervision, special departments for such services. With few exceptions, the old-fashioned method of burning-on a part of a casting broken off is too expensive and messy under modern conditions and the newer methods should be investigated. As a first move in the right direction, it would be well if an impartial body could carry out trials, publish the results and expand the foundry industry's knowledge of the subject. This would give their customers good grounds for co-operating in individual cases and so build up data for the general good of everybody. Then, if a foundry were carrying a rejection loss of between 5 and 12 per cent., it might be worthwhile to get a welding expert to say what quantity could be salved and at what cost.

Touring Exhibition of Industrial Equipment

A first "Touring Exhibition of Industrial Equipment" was opened by the Mayor of Croydon (Alderman H. Lock Kendell, J.P., C.ST.J.) on Tuesday, April 26, at the Aerodrome Hotel, Croydon. In his speech of welcome, the Mayor said that it was particularly timely that such an exhibition should tour the country. Many new factories were being built needing modern equipment and facilities which, in turn, would create a demand in older factories for up-to-date equipment to keep their working conditions in line. The exhibition is organized by Mr. W. G. Appleyard and is based on the idea that the products of the exhibitors be taken to districts where prospective customers exist rather than expect interested persons to travel to one or other of the national exhibition centres. The exhibition stands can be easily dismantled for transit and subsequently re-created at the new venue. In each area to be visited by the exhibition, invitations are being given to works managers, production engineers and other executives in industry along with architects who would be interested in the application of several of the products shown to building construction.

The first exhibition is to continue on tour for 13 weeks and will visit West London, North London, Cardiff, Manchester, Newcastle, Glasgow, Liverpool, Leeds, Birmingham, Leicester, Bristol and Southampton. From Croydon, the exhibition moved to the London area and could be visited this week (May 3-5) at the Town Hall, Chiswick, and at Ewen Hall, Wood Street, Barnet, on May 10, 11 and 12. Dates and places of the other tours are summarized below; tickets can be obtained from Mr. W. G. Appleyard, 71, Broad Street, Birmingham, 15.

Cardiff, May 17 to 19 at Park Hotel; *Manchester*, May 24 to 26, at Milton Hall; *Newcastle*, May 31 to June 2, at Durant Hall; *Glasgow*, June 7 to 9, at McLellan Galleries; *Liverpool*, June 14 to 16, at Central Hall; *Leeds*, June 21 to 23, at Griffin Hotel; *Birmingham*, June 28 to 30, venue not yet announced; *Leicester*, July 5 to 7, at YMCA; *Bristol*, July 12 to 14, at Royal Hotel, and *Southampton*, July 19 to 21, at City Hall. At each centre, the exhibition will be open from 11 a.m. to 6 p.m.

Exhibitors

The following manufacturers and companies have combined to display their products and services:

Commando Industrial Services, Lloyds Bank Chambers, Warwick, offer a comprehensive cleaning and maintenance service, including boiler de-scaling, repairs to all types of refractory brickwork—industrial furnaces, boilers, incinerators, cupolas, corestoves and ovens. In addition, the company undertakes the cleaning of windows and rooflights, protective painting of steelwork, external and internal painting of buildings, painting of plant and complete cleaning of fuel tanks.

Hughes-Johnson Stampings, Limited, Light-Metal Forgings, Limited, Oldbury, Birmingham, exhibit a number of forgings in a variety of materials ranging from carbon steels to titanium and including a number in aluminium alloys.

Industrial Fan & Heater Company, Limited, Evelyn Road, Birmingham, 11, have on show a new propeller fan, the range of which covers 12 to 24 in. inclusive. The motors are totally enclosed, air-stream rated, squirrel cage, induction machines. The impellers are six-bladed and the motors are supported by four die-cast aluminium arms resiliently mounted. Other types of fans and heaters for use in factories, etc., are on view in addition to a roof ventilator in sizes from 12 to 24 in. made from resin-bonded glass-fibre.

Tirfor, Limited, 27, Broomgrove Road, Sheffield, 10, exhibit lifting and pulling equipment which offers any height of lift or length of pull; capacities are from 1 to 12 tons.

Charles Smith & Son (Woodcraft), Limited, 82, Hurst Street, Birmingham, 5, specialise in the machining, turning and carving of wood. The company offers its services in the machining to specification, carving of all types of architectural and patternmaking requirements, and wood-turning to fine limits for handles, bowls, etc.

West Instrument, Limited, 52, Regent Street, Brighton, 1, have on view temperature-control instruments and thermocouples for the plastics industry, furnace and general heat-treatment equipment.

Firth Cleveland Tools, Limited (Surform Division), Stornoway House, Cleveland Row, St. James's, London, S.W.1, exhibit a complete range of their Surform and Surcut hand-tools and power-tool attachments. The wide range of materials on which Surform tools can be used extends to all metals up to a hardness of mild steel.

IVE Notes

Approximately 65 members, their ladies and guests, attended the annual social evening of the Southern section of the Institute of Vitreous Enamellers held on Friday, April 29. The event commenced with dinner at the Connaught Rooms where, in the absence of Mr. Colin Stokes (section chairman) owing to indisposition, Dr. B. K. Niklewski presided. Accompanying him at the top table were Mr. E. W. B. Dunning, Mr. N. Parker, Mr. G. L. Thompson, Mr. B. B. Kent, Mr. J. D. Gardom, Mr. L. E. Turner, Mr. M. F. Ball, Mr. N. M. B. Kent and Mr. G. L. Hudson, most of whom were accompanied by their ladies. At the end of the dinner, Dr. Niklewski, after the Loyal Toast, suggested that a letter of sympathy be sent to Mr. Stokes and this was agreed. He then expressed a welcome to the ladies, the members and officers of the Institute, and proposed a vote of thanks to the secretary (Mr. Turner) for the arrangements that evening. Mr. Thompson expressed the gratitude of the gathering to the chair.

The dinner was followed by a visit to the London Casino Theatre to see the Cinerama presentation "South Seas Adventure"—a performance which rounded off a very successful informal function.

Forty Years Ago

It was typical of the foundry industry in the second decade of the century, that a scientist should be invited to address a meeting consisting mainly of practical men, plus a few metallurgists. Such a meeting, reported in the May, 1920, issue of the JOURNAL, was held in Sheffield with Dr. W. H. Hatfield presiding. Dr. F. Rogers, D.ENG., B.A., M.SC., who was the lecturer on "Factors Contributing to the Soundness of Castings," opined that the production of the internal combustion engine was a founder's idea rather than an engineer's. He advocated the use of pyrometers in the foundry, but one of the practical men at the meeting insisted that placing a standard rod into the melt for ten seconds and noting the effect, was an equally good, if not superior, method of measuring temperature. No doubt everybody went away from this, and similar meetings, not much the wiser. Amongst "New Companies" listed, appeared the names of Talbot Stead Tube Company, Limited; Whessoe Foundry & Engineering Company, Limited; Thomas Wilson & Sons (Swalwell), Limited, and Ealing Park Foundry, Limited.

Refractories*

By D. Dixon

Notes on the history of refractories are followed by a description of each of the principal groups, *i.e.*, " acid," " basic," alumino-silicate and " sundries." The refractories which are most important for frit melting and fusing furnaces are then dealt with, and the paper concludes with extracts from an interesting discussion which followed its presentation at a recent meeting of the Institute of Vitreous Enamellers.

In the course of a recent lecture, Professor James White, of the refractories department of Sheffield University, stated that the earliest known fabricated firebricks appear to have been used by the Assyrians for metal melting during the Middle Bronze Age, about 700 B.C. These firebricks were manufactured from clay and sand—a relatively sophisticated mixture designed to minimize shrinkage during drying and firing. This type of mixing is still known to-day. Evidently the problem of how best to control volume changes during drying and firing of refractories, so as to secure the required dimensions, is not new. Professor F. H. Norton, in his well-known book on refractories, refers to the use of silica in the form of sandstone 200 to 300 years ago for kilns and furnaces in North America. Sandstone may have a longer history than firebrick, and probably it was used with the line of cleavage vertical to the working face, so as to avoid shelling in service.

Mr. F. H. Clews, the present president of the British Ceramic Society, in his contribution to the Symposium on Refractories published by the Society in 1953, refers to the lack of knowledge about the fireclay brick industry before this century. Certain fireclays were recognized as better than others for certain purposes, but it seems that no one knew why. In the absence of informative literature, it can only be assumed that for many years before this century the refractories available in Great Britain were based on silica from the Dinas deposits in South Wales, and on fireclays found chiefly in Stourbridge, Yorkshire and Scotland.

Progress during Present Century

The foregoing helps one to appreciate the progress made during the present century. The last 30 to 40 years particularly has been a time of great change and expansion for the refractories industry, as for other industries. Some may say that the scientists and technologists have run ahead of those who have to produce refractories on a commercial basis from the plant and materials available to them. Indeed, the reward of pioneers in the application of scientific research is often worries rather than profits. This is very true in the case of refractories, for the relation between raw materials, processing methods and final properties is very complex. W. D. Kingery refers to this in his introduction to the book " Ceramic Fabrication Processes," published last year under the auspices of the Massachusetts Institute of Technology. There are now many raw materials for refractories, many manufacturing processes, and a great variety of uses requiring different properties. The trend is for refractories to be " tailor made " for specified jobs.

PRINCIPAL GROUPS OF REFRACTORIES

The enamelling industry particularly, like its near relative the glass industry, requires a variety of refractories with conflicting properties. So it is useful first to name the recognized groups, with a brief description so as to get something of a complete picture, and then to discuss the refractories which are most important for frit melting and fusion furnaces.

The output in Great Britain is about 2,000,000 tons yearly, comprising, in very round figures, about 1,000,000 tons fireclay, 500,000 tons of high alumina, silica and basic, and the remainder ground fireclay, cements, monolithics and sundries. The usual classification is:

(1) " Acid " group, consisting of silica and semi-silica.

(2) " Basic " group, consisting of magnesite chrome, dolomite and forsterite.

(3) Alumino-silicate group, consisting of fireclay and the high-alumina grades based on kyanite, sillimanite, andalusite and bauxite.

(4) " Sundries " group, which includes carbon, plumbago, silicon carbide, fused alumina, zircon, pure oxides and cermets.

" Acid " Group

The silica rock known as quartzite is crushed, graded and mixed with a little lime, plus some organic bond such as sulphite lye to give green strength. Bricks and shapes are formed by pressing or tamping. They are fired in intermittent or tunnel kilns up to 1,450-1,500 deg. C., which converts the quartz into the forms known as tridimite and cristobalite.

* Reproduced by permission of the Institute of Vitreous Enamellers.

Refractories

A recent development has been the calcination of flints as a material for high-grade silica brick. The fusion point of silica is given as 1,710 to 1,725 deg. C. Because they remain rigid and volume stable at temperatures close to their fusion point, silica refractories are used for continuous service under load, as in the sprung roofs of open-hearth furnaces and glass-melting tanks, in coke ovens and in gas-making retorts. However, they have a reversible thermal expansion which is somewhat high and irregular, so they are unsuitable for furnaces operated intermittently with frequent temperature changes. Alumina is an impurity in silica refractories. During recent years, silica refractories have been improved by reducing the alumina content to less than 0.5 per cent., and by reducing porosity to as low as 20 per cent. Their scope, however, is decreasing because of the trend towards basic refractories in the steel industry.

Semi-silica refractories, composed of silica-clay mixtures natural or prepared, are useful for some medium-temperature furnaces, though they have a relatively low fusion point. This may be as low as 1,545 deg. C. for the mixture of 94.5 per cent. silica and 5.5 per cent. alumina. The action of flux-laden combustion gases and fuel slags on the heated surface of semi-silica refractories is to form a brick-slag interface or skin which resists abrasion and erosion at medium temperatures, as, for example, in the walls of soaking pits for reheating steel ingots. The mixture of silica and clay known as ganister is an example of semi-silica for facing cupola-furnace linings, and for rammed linings of certain rotary and high-frequency induction furnaces.

"Basic" Group

Dr. G. R. Rigby, in a paper to the International Ceramic Congress in Vienna in 1957, stated that basic refractories, manufactured from magnesite and from mixtures of magnesite and chrome, have only one advantage over silica, namely their higher refractoriness. But this is an important advantage in steel melting. The fusion point of pure magnesia is given as 2,800 deg. C., and the maximum service temperature of basic refractories, composed of various mixtures, approaches 2,000 deg. C. In properties other than refractoriness, basic refractories are inferior to silica or high alumina as they have higher bulk density, lower load-bearing capacity, higher thermal conductivity, and a lower resistance to temperature changes, whilst, chemically and physically, they are less stable in service. One weakness in service is the tendency to shelling of the hot face, because of changes in temperature and furnace atmosphere—a form of wastage which is more complex than simple thermal spalling.

Because of their resistance to alkaline dust, basic refractories are being used in certain other continuously-operated furnaces, examples being the firing zone of rotary cement kilns and the checkers of glass-melting furnaces. Some basic grades are chemically bonded and steel cased so that they do not have to be kilned. Most of the magnesite used in Great Britain is now produced from sea water on the North East coast, calcined into the form known as dead burnt magnesite or periclase.

Alumino-silicate Group

So the needs of the enamelling industry, as known at present, are met by the alumino-silicate group plus some silicon carbide and fused alumina which are useful because of their high thermal conductivity. The Bowen-Greig-Schairer graph of refractoriness indicates fusion points of 1,710 to 1,725 deg. C. for silica, falling to 1,545 deg. C. for 94.5 per cent. silica/4.5 per cent. alumina, rising to 1,750 deg. C. for 42 per cent. alumina fireclay, to 1,810 deg. C. for mullite having 72 per cent alumina, then to 2,050 deg. C. for pure alumina. The chemical formula for pure clay or kaolin is Al_2O_3 $2SiO_2$ $2H_2O$, giving an alumina content of roughly 40 per cent. Great Britain is fortunate in having fireclay deposits for firebrick with a fired analysis of 35 to 42 per cent. alumina. Scottish manufacturers, particularly, with the combination of good fireclay deposits, modern plants and convenient ports can export to distant markets. The china clays of Cornwall have become more important of recent years in the form of calcined grog, chiefly because this grog can be manufactured into firebrick with over 40 per cent. alumina and a low iron content.

Manufacturers and users have for many years valued fireclays chiefly by their alumina content. During the last 25 years, however, scientists have provided much information about the structure of the variety of clays. They have grouped clays according to the arrangement of the atoms of silicon, aluminium, oxygen and certain impurities in the lattice of the clay molecule. Two of the chief groups are kaolinite, which includes china clay, and montmorillonite, which includes bentonite. Fireclays consist chiefly of kaolinite, or a disordered form of kaolinite which some describe as levisite. Alan S. Michaels, in "Ceramic Fabrication Processes," has written that the primary particle of kaolinite can be considered as a plate-like stack of alumino-silicate leaflets.

Limitations of Fireclay Refractories

This research into the structure of fireclays has helped to define the limitations of fireclay refractories. Though a 42-per-cent. alumina fireclay may rightly be regarded as better than a 35-per-cent. alumina fireclay for many purposes, we know that there can be no super fireclay to meet many conditions of high-temperature service. Moreover, the fireclays as mined and used, since cost of beneficiation is usually prohibitive, contain troublesome impurities such as free silica, iron oxide, lime and alkalis. Firebrick formed by hand-moulding or extrusion from soft plastic mixes of high water content has high shrinkage in drying and firing, so that it is not possible to maintain close dimensional tolerances in output from a kiln. This has led to the trend towards the use of precalcined aggregates in semi-dry mixings having 5 to 10 per

cent. water content, machine pressed or tamped and fired in tunnel kilns to ensure close control of final heat-treatment. The aggregate or "grog" in the mixing may be calcined fireclay, or an imported mineral such as kyanite, sillimanite, andalusite or bauxite.

The properties available in refractories are: high or low thermal conductivity; high or low porosity; resistance to high temperature, sharp temperature changes or slag attack; volume stability over long periods of service, and strength at high temperatures under load—some of these properties are conflicting. Selection may sometimes be difficult also because the user cannot define clearly the conditions of service in the furnace. Alumina content or high fusion point may not be the most important properties.

The chief cause of wear and wastage of refractories in service is solution and erosion by slags and flux-laden furnace gases. Low porosity and low permeability are important in this connection. The porosity of brick pressed from highly-refractory non plastic grogs with minimum of bond may be as high as 25 to 30 per cent. In plastic-formed steel-ladle brick to resist the solvent effect of the slag in the ladle it may be 15 per cent. or even less. W. D. Kingery has written that the effect of fabrication techniques on resultant properties has only just begun to receive the attention it deserves —there are many of these techniques. Apart from material preparation and kilning, they include hand moulding, soft extrusion, with or without de-airing, extrusion and repress, stiff plastic pressing, semi-dry pressing, tamping, slip casting and electric fusion casting. De-airing of the batch by vacuum mixing or vacuum extrusion to secure low porosity and tough texture has been a noteworthy development.

High-alumina Grades

The three crystalline alumino-silicate grogs, kyanite, sillimanite, and andalusite, which come to Great Britain chiefly from India and Africa, have an alumina content of about 60 per cent. They differ, however, in crystal shape and specific gravity. In a paper to the International Ceramic Congress in 1954, M. C. Thomas and M. R. Fourneau gave the specific gravities as kyanite 3.60, sillimanite 3.23 and andalusite 3.15. All are converted by high temperature into mullite with an alumina content of about 70 per cent., plus some freed silica in the form of cristobalite or siliceous glass. According to the foregoing authors, the requisite temperatures for the conversion are 1,350 to 1,380 deg. C. kyanite, 1,545 deg. C. sillimanite and 1,380 to 1,400 deg. C. andalusite. The fusion point of mullite is 1,810 deg. C., the specific gravity is 3.16, and the structure is a mass of interlocking needle-shaped crystals. The Bowen-Greig-Schairer phase diagram shows that mullite is the only alumino-silicate which is stable at high temperatures of the order of 1,600 to 1,800 deg. C.

Synthetic mullite grogs can also be produced from mixtures of alumina and silica by high-temperature treatment, the theoretical proportions being 72 per cent. alumina and 28 per cent. silica. Electrically-fused mullite grogs are now used, both in USA and in this country, for the manufacture of high-grade mullite refractories having no free silica. So the nomenclature of the many grades of high-alumina refractories is confusing to the user, and it needs to be clarified. Many so-called sillimanite refractories are based on calcined kyanite, which can be converted most readily to mullite. It is true that sillimanite and andalusite are suitable, without prior calcination, as grog when the refractories are to be used below the conversion temperature, as for example in glass melting. Blocks cut from lumps of raw Indian sillimanite are used for the walls of glass-melting tanks. For higher temperatures, calcination is advisable to avoid crystal change in service. Bauxite is a material for corundum grog, but needs to be well calcined to ensure low porosity and freedom from shrinkage in service. If bonded with clay, it may combine with silica to form mullite, and show expansion in service.

The value of these 60 to 75-per cent. alumina refractories provided that high-temperature heat-treatment has secured full development of the interlocking mullite crystals, is in their freedom from after-contraction, their refractoriness under load, their resistance to many slags, and their safety from fracture under temperature changes. High alumina content increases the viscosity of the brick/slag interface, so that erosion by impinging combustion gases is slower than would occur with fireclay.

Finely-ground calcined kyanite is a useful constituent of high-temperature jointings. Raw kyanite may also be a constituent, because its expansion on conversion to mullite in service helps maintenance of tight joints. According to a test of 32 refractory jointings, described by G. R. Eusner and J. R. Bachman, published in the *Bulletin* of the American Ceramic Society of January 15, 1958, the three brands which met all requirements contained a proportion of raw kyanite.

"Sundries" Group

Space does not permit of a review of the many refractories in the "sundries" group, for their properties and uses are very specialized. Some uses are well established, such as carbon blocks in blast-furnace hearths, and pure alumina tubes in molybdenum wound tube furnaces. Others, such as cermets, are still in the development stage, with potential uses in nuclear reactors, gas turbines and rocket drives. The most important amongst sundries for the enamelling industry are silicon carbide and the fused alumina, which is distinct from the calcined bauxite, usually known as corundum. Both are abrasive grits produced by fusion in electric furnaces, and they are also refractory grogs.

Silicon carbide has no fusion point but dissociates at over 2,000 deg. C. A limitation to its use is that the carbon content burns in a strongly oxidizing atmosphere, particularly at medium temperatures of 800 to 1,000 deg. C. or if steam is

present, leaving a disintegrated silica body. Silicon-carbide refractories have a high thermal conductivity, they are very stable at high temperatures under load and the rapid heat diffusion obviates thermal spalling strains. They have a "non-wetting" surface, particularly when air or water cooled, and this helps resistance to fuel slag attack. For purpose of comparison, thermal conductivities can be given as 29 to 30 silicon carbide, 10 to 12 fused alumina, 5 to 6 firebrick, 2 insulating brick, calculated as BTUs per sq. ft. per hr. per 1 in. thick per 1 deg. F.

Zircon is a zirconium silicate of 67.25 zirconia and 32.75 silica. Zircon refractories are recommended for reverberatory aluminium-melting furnaces, and for furnaces melting heat-resisting borax glass and opal glass. They are suggested also for furnaces melting high-lead frits and cover-coat frits containing antimony, titanium or zirconium, but there appears to be greater use in USA than in Great Britain.

Two developments in the refractories industry since the war are outstanding. One is the great increase in the production and use of special-purpose coatings, jointings, patchings, rammings and castables—particularly the refractory concretes composed of grog and aluminous cement for the installation of monolithic linings, and described as castables. The maximum service temperature of these concretes, with fireclay aggregate or grog, has been 1,300 to 1,350 deg. C. New grades of aluminous cement, calcium aluminate with a very low content of silica and iron oxide, are now available. With highly-refractory grogs, such as mullite or corundum, they can be used for service up to 1,750 to 1,800 deg. C. The other development is the porous firebrick of low heat capacity for high-temperature thermal insulation. Formed from mixtures of fireclay and wood dust, the carbon is burned out in kiln to give a porous brick which is then machined to shape and size. Porous silica and basic refractories have also been developed.

Selecting from the foregoing review of available refractories, the following seem to meet present needs of the enamelling industry according to application:—

ENAMEL-FRIT MELTING

The property required in the linings for frit melting is not high refractoriness, but resistance to solution and erosion by molten frit at medium temperatures. This indicates fireclay brick of around 40 per cent. alumina and low iron content, with low permeability and homogeneous texture, close dimensional tolerances and flat or slightly concave setting faces. Manufacture by semi-dry pressing and tunnel-kiln firing is a sensible preference. Fine-meshed and smooth-working aluminous cement, air setting, helps to thin tight jointing. Courses of dense high-alumina brick at the bottom of side walls of stationary furnaces, or a projecting curb, help to meet the more severe attack at this area as the frit melts.

The constituents of the frit are a factor to be considered. Guidance as to the most suitable brick can sometimes be secured by the comparative test of heating samples of frit on alternative refractories, and then examining the extent of penetration and chemical reaction. Monolithic linings of plastic alumino-silicate ramming are an alternative for rotary furnaces. Good service from a zircon ramming mix on high-lead frits has been reported. A producer of ceramic frits has stated that zircon bricks are better than high-alumina bricks if the frits are not sensitive to zircon pick-up, and mentions increasing advantage from monolithic linings.

FUSING FURNACES

The variety of fusing furnaces, batch or continuous, gas- or oil-fired or with electric resistor heating, require a variety of refractories. The old type of batch furnace, fired by solid fuel or built-in semi-producer, was built of fireclay brick with a fireclay panel brick muffle. The later batch-types of fusing furnace, oil or gas fired, would also have fireclay brick, Scottish or equivalent, for the outer construction, cased with porous fireclay brick to reduce heat capacity and radiation losses. Fused-alumina brick has been widely used for the piers and ports of the oil-fired combustion chambers below the muffle, but mullite brick based on highly calcined or fused mullite grog without free silica has now come into use, and it may be preferred to secure the stability under load at a soaking high temperature. Silicon-carbide or fused-alumina panel bricks or slabs secure the thermal conductivity required in the muffle shell, including the floor. Silicon-carbide may be preferred to fused alumina in oil-fired furnaces taking heavy charges, such as cast-iron baths, because of its higher thermal conductivity and the faster heat recovery.

Oil firing maintains better than gas firing a glassy surface on the silicon-carbide bricks, to resist oxidation, as do also the enamel vapours on the interior of the muffle. For sheet enamelling, a fused-alumina muffle and a mullite combustion-chamber seem now to be the best selection. For filling the muffle door, a castable of aluminous cement and fireclay grog is useful. Then there is the radiant-tube furnace, with its construction of flue tubes forming the muffle to give a large radiant surface. The radiant tubes may be of the equivalent of Scottish fireclay, but metal is the alternative when a plus pressure inside the radiant tubes requires a non-permeable material.

Continuous Type

For continuous furnaces, the selection of refractories is on similar considerations, with fused-alumina panels or rectangular tubes in the side walls to give heat transfer. In the roofs of continuous-conveyor furnaces, where the refractory is in suspension, the property required is safety from fracture due to the temperature gradient. Large blocks spall more readily than standard bricks, apart from the greater possibility of texture faults. The selection therefore is well-shaped fireclay blocks of coarse and so-called elastic texture. This applies

the principle that a coarse texture, or a texture without a glassy bond, has a multitude of minute cracks to accommodate volume change, though the blocks may grow very slowly in service. Another method for these blocks is the addition of a magnesium silicate, such as talc, to the block mixing to form a cordietite-type bond in kilning, as cordietite has a very low reversible expansion, though the maximum temperature of use may be 1,300 to 1,350 deg. C.

Electric Furnace

For the electric fusing furnace, thermal conductivity is discarded as a property required for the muffle with its internal heating. The selection is material with good electrical insulation to carry the metallic (or for high temperatures, silicon-carbide) heating elements. Tiles of sillimanite or calcined kyanite provide better electrical insulation than fireclay, and should also be free of iron-oxide spots, which may permit electrical leakage. An external casing of porous insulating-brick provides thermal insulation. Alternatively, the heating elements may be fitted into shapes of hot face insulating firebrick. A thin coating of air-setting aluminous cement on the face of the insulating firebrick hinders penetration by enamel vapours and improves radiation.

CONCLUSION

Finally, there should be mention of the mullite-porcelain sheaths for protection of rare-metal couples, the recrystallized alumina insulators (free of silica) for the thermocouple wires within the sheath, and the clay crucibles for melting small quantities of frit. The enamelling industry is a small market, in terms of tonnage, for the refractories industry, but is specialized. It is hoped that discussion on this paper will reveal some user experience of general interest.

* * *

DISCUSSION

At the commencement of the ensuing discussion, Mr. Dixon was asked if zircon refractories had low permeabilities. He replied that he had no information that zircon refractories generally were less porous than the alumino-silicate type. It seemed difficult to obtain experience in this country on the use of zircon. He had enquired of one of the suppliers of zircon, and was informed that users did not talk much about their experience, but there was information that bricks containing some zircon had done well in a frit kiln.

Effect of Sulphur in Oil Fuel

Another questioner enquired as to the effect on a high-alumina refractory in a furnace at 1,100 deg. C. of oil fuel having a sulphur content of 3½ per cent., compared with oil fuel of lower sulphur content. Mr. Dixon answered that trouble from reducing conditions, caused by unburnt carbon or sulphur, was the effect on the iron oxide in the refractories. Manufacturers of refractories endeavoured to minimize iron-oxide content, but, even in refractories containing kyanites and sillimanites, some iron oxide was present. The effect of reducing was to convert ferric oxide to ferrous, and reduce refractoriness. Also, it was well known that in blast-furnace linings free iron-oxide had a catalytic effect on carbon monoxide from the fuel, so that finely-divided carbon was deposited in the pores of the firebricks, and had a disintegrating effect.

The questioner then said that Mr. Dixon was assuming a reducing atmosphere, to which Mr. Dixon replied that reducing conditions were bad for alumino-silicate refractories; the sulphur should burn, but if it did not it might cause trouble.

Another of those present said that, so long as reducing conditions were avoided, it would not be possible to detect any effect from sulphur on the refractories. To achieve reducing conditions where sulphur would be a reducing agent with oil fuel, large quantities of unburned carbon and carbon monoxide must be present. The effect of carbon monoxide and carbon particles on the refractories was fairly well established. Sulphur did not enter into it very much unless there were reducing conditions.

The original questioner (on oil fuel) remarked that there was no carbon monoxide, to which the same speaker replied that it was impossible to say that, because oil could burn in two completely different ways. One could burn by pure oxidation in simple processes, reducing carbon monoxide to carbon dioxide, or with paraffin burners one could burn acetalde hydrically. One could, in fact, get hydrocarbons which were partially oxidized; they were foul-smelling and produced the blue plume associated with incomplete combustion. The hydrocarbon was only partially oxidizing, due to the gradually reducing temperature. If one still had oil trying to burn at low temperature, one should get partial oxidation of hydrocarbons.

Mr. Dixon, supporting this speaker's remarks, said he had met troubles with furnaces due to bad combustion and reducing conditions, but he could not recollect troubles due solely to the presence of sulphur in the fuel. This discussion confirmed his impression, he said, that, in spite of claims made for them, zircon linings had not yet been adopted successfully in rotary or stationary frit furnaces in the UK.

Complex Conditions of Manufacture

A further speaker at this point said that one was always up against the point that, while refractory materials available were so very diverse and varied in their compositions and properties, unfortunately, the working conditions in furnaces in the enamelling industry were just as complex. One could get a refractory lining which for over 95 per cent. of cases would give the results required, but in the remaining few cases it would fail due to some local condition which it was exceedingly difficult to find. Troubles arose due to incomplete combustion and a number of other causes, and these were factors which did not constitute a reflection on the manufacturer necessarily, but they provided a reminder that his job was extremely difficult.

Refractories

Following this comment, another speaker, enlarging on the point that both maker and user of refractories had important roles to play, recalled that Mr. Dixon had mentioned use of a continental silica rock which was first class, but the effect of crushing and bonding with clay to make special shapes had not been realized. Some manufacturers had installed tunnel kilns and other improvements to ensure right manufacturing conditions. He emphasized that the user had a responsibility perhaps even greater than that of the maker of refractories.

Need for more Process Control

Mr. Dixon, thanking the last two speakers for their remarks, said he realized that there was more to be done yet in process control by the refractories industry. For many years refractories had been fired in intermittent kilns, where there might be quite a range of temperature from top to bottom. Tunnel kilns giving more accurate control of heat-treatment were coming into use, and that helped, combined with more knowledge of raw materials and more realization of the effect of different manufacturing processes on the final products. The manufacturer of refractories, however, had always to bear in mind what he could afford to spend, because the customer had to pay eventually for improvements. The manufacturer had to consider what price he could get, and that was quite a problem. Apart from that, Mr. Dixon thought that a shrinking and more difficult market generally for refractories was approaching. Manufacturers who were going to survive had to consider processes and control right along the line.

FTE & SA Luncheon

An addition to the normal sequence of events in the annual proceedings of the Foundry Trades Equipment & Supplies Association was the first of a series of biennial luncheons for members, held at the Waldorf Hotel, London, on Wednesday of last week. Mr. Gavin C. Paterson, president of the Association, took the chair at the quite informal gathering, which was attended by about 40 representatives of member-firms including a number of past-presidents. The objective of the meeting was to inaugurate a series of more-frequent discussions between members on items of current interest, and after the luncheon a number of such topics were brought up for general comment. It was agreed that such meetings are valuable and are likely to be continued, though the London venue did not meet with universal approval, the alternative of Birmingham being suggested. Amongst other business, it was announced that provisional arrangements had been made to book Bingley Hall, Birmingham, for the period April 29 to June 1, 1963, for the staging of the next British Foundry Exhibition (this period, of course, including the period for dismantling and setting up). It was also disclosed that the handbook committee of the Association is engaged on proposals for a larger and more-elaborate publication, describing members' productions. It was hoped to have this ready before the 1963 exhibition, to print it in French and German as well as English, and members' ideas were now being sought as to format and contents. Other topics ventilated at the gathering were the idea of having the annual dinner in Birmingham, the arranging of Exhibition publicity; European trade; a Government publication on the raw-material situation, and possible liaison in research.

American Die-casters en route for Stresa

In the premises of the Zinc Development Association at Berkeley Square, London, a meeting was arranged on Monday of this week between members of British die-casting firms and visiting delegates of the (American) Society of Die Casting Engineers (as well as representatives of the technical Press). The visitors comprised a group of Americans who are undertaking a preliminary European tour prior to participation in the Stresa International Die Casting Conference (announced in the JOURNAL, April 7) which commences on May 16. The meeting took the form of a cocktail party arranged under the auspices of the Zinc Alloy Die Casters' Association, and the American delegates, numbering about 45, were thus able to meet their British counterparts for informal "shop talk." Mr. J. A. Goddard (chairman, ZADCA), officially welcomed the American visitors, and Mr. Harry Cagin (of Halex Die Casting Company, Cleveland, USA), who is chairman of the Society of Die Casting Engineers' European Tour Committee, replied for his party and expressed appreciation of the arrangements made for them in this country. These included visits to Sparklets, Limited, and Fry's Die-castings, Limited, in the London area on Monday, Birmingham Aluminium Casting (1903) Company, Limited, on Tuesday, Wolverhampton Die Casting Company, Limited, on Wednesday, and High Duty Alloys, Limited, at Slough, on Thursday of this week.

The American party are to leave London at the end of the week for France, Germany and Switzerland *en route* for Stresa, in Italy—their whole tour occupying about one month. In all these countries they will be making further visits to foundries, including the establishments of Fonderie Précision, near Paris, Postel Spritzguss in Cologne, Hanselwerke at Meschede, Daimler-Bentz at Stuttgart, Bühler Bros. at Winkelm and Injecta AG at Teufenthal.

Complimentary comments were passed by the visitors on the smoothness of their reception in the UK, both at the Customs and by representatives of the travel agency they had employed. Single-party coach travel for all the journeyings in this country was arranged, and this was a great convenience and contributed much to keeping the party together. Many of the American delegates engaged in the tour are accompanied by their wives, who spent their time in the UK on shopping and sightseeing excursions while their menfolk were engaged on the "plant visitations," as they call them. Mr. A. R. L. Chivers (of ZADCA) was responsible for many of the arrangements, in co-operation with the European Pressure Die Casters' Committee, and the Americans were undoubtedly most grateful for the programme of visits provided.

Reciprocal Trip ?

From November 8 to 11 this year, there is to be held at Detroit a National Die Casting Exposition and Congress, and it is thought that there may be British and Continental contingents travelling to America on that occasion. Certainly, the recent developments in American die-casting practice relative to the automobile industry make such a visit attractive to delegates from Europe. The Exposition will be housed in the Artillery Armory Building at Detroit and will occupy approximately 27,000 sq. ft. of space; about 100 prominent American manufacturers, in addition to some from overseas, are expected to occupy stands.

Association of Bronze & Brass Founders

Annual Social Event and Meetings in London, April 26-27

Preceding the annual general meeting of the Association of Bronze & Brass Founders, held on April 27 at the Connaught Rooms, London, there was held a social evening on April 26. This was an informal affair, attended by about 90 members, their ladies and guests. First, there was a cocktail party in the Savoy Hotel. This was followed by a visit to the Adelphi Theatre to see "When in Rome. . . ." Afterwards, the party returned to the hotel for supper, cabaret and dancing until the early hours.

GENERAL MEETING

Little evidence remained of the previous night's activity when members re-assembled next morning at the Connaught Rooms at the general meeting. The chair was taken by the president, Mr. A. J. N. Brown (Stevens, Struthers, Limited), and about forty member-firms were represented. After the formal business of apologies and minutes, new members were announced as the Roadend Foundry, Huddersfield, and J. Stone & Company (Propellers), Limited, London. Five resignations were also announced. The next item on the agenda was the president's report.

President's Report

In reporting the activities of the past year the president addressed Association members in the following terms:—

Since the last annual meeting there have been four meetings of the Council, all of which have been well attended. A large number of subjects of considerable importance to the industry have been dealt with—of particular interest are the following:—

European Foundry Apprentices' Competition

This competition is to be held in this country next month and there will be competitors from a number of European countries which are members of the European Committee of Foundry Associations. Arrangements for the competition have been in hand for considerably more than 12 months and have involved a great deal of work for those responsible. The Association's representative on the organizing committee, Mr. G. H. Charsley, has taken a great interest in this matter and worked very hard both with arrangements and with candidates from non-ferrous foundries.

With a view to interesting these boys in the competition and to encourage them to enter for the European Competition, Mr. Buxton organized and supervized a competition in the London area. It was not possible to follow this up in the other areas owing to lack of interest by boys.

To conduct this competition is expensive and the Association has assumed responsibility for a share of the cost up to £1,000 on behalf of the non-ferrous founders in this country. The Association feels sure that the interest in the foundry industry created by this competition will be of great benefit to the industry as a whole. The non-ferrous industry is not training sufficient craftsmen and without these it cannot function efficiently. The competition will help to remedy this state of affairs.

Recruitment and Training

Continuing on the subject of recruitment and training, I would like to thank members for the information supplied to the Association early last year about the number of apprentices in their works and the educational facilities available to them. These facilities are often lacking but, on the other hand, where they are available, it is sometimes very difficult to persuade young people in the industry to take advantage of them.

The Ministry of Labour has stated that the training of apprentices is a matter for industry. Apprentices do, of course, obtain good practical training in the foundry itself, but the ABBF maintains that at least general education is the responsibility of the education authorities. In this industry, which has so many small firms, it is not economic to provide wider training in the firm. Therefore, to ensure the continued well-being of the industry itself, which is basic to the well-being of engineering as a whole, it is essential that courses in foundry work be available at many local centres.

Safety, Health and Welfare in Non-ferrous Foundries

During the last year the second report of the Advisory Committee, which deals with health matters, has become available and late last year draft Non-Ferrous Foundry Regulations were issued by the Ministry of Labour. These draft Regulations have been carefully considered and the observations of the Association will be given to the Ministry.

I am sure it is agreed that, by and large, the conditions envisaged by the Regulations are desirable for the good of the industry, and indeed in many foundries they are already largely put into effect. In some foundries, because of limitation of space and for similar reasons, the proposals will be difficult to implement and therefore, apart from certain criticisms, the Association is urging that sufficient time should be given before they come into force to enable firms to take the necessary steps.

The reputation that the foundry is a bad place in which to work is mostly out-dated. With modern conditions, the foundry has come to take its place with many other branches of industry as a good place in which to work, with high pay and, moreover, it is an occupation in which the employee can take an interest because of the creative nature of his work.

I would like to record our appreciation of the work of ABBF representatives, Mr. P. B. Higgins.

Association of Bronze & Brass Founders

Mr. W. T. Hobkirk and Mr. E. Ayres, on the Committee, and especially the work done in the early stages by Mr. G. T. Hyslop who resigned on the completion of the first report.

European Free Trade Area

Members will have read about the association of the Seven Countries which has been created and the hopes that an arrangement may be reached with the countries of the Common Market. It is not my particular province to comment on the wider aspects of the agreement. If it results in increased trade, founders should, of course, all benefit; but the Association's particular interest has been to bring home to the Government the importance of retaining for the benefit of British industry the scrap metal arising in this country from the activities of industry, and the Association is pleased that it has been able, in co-operation with others holding the same views, to bring this matter strongly to the attention of the Government and that, as a result, for the time being at least, scrap metals are exempted from the arrangement for the early freeing of exports from control.

European Committee of Foundry Associations

Consideration of European Free Trade areas leads to consideration of the European Association of Foundries which is not subject to the limitations of the "six" or the "seven" but is open to the foundry associations in all European countries and in fact has a membership of eleven countries. A statement on the aims and activities of the European Association is being prepared and will be published before long. The speech made by the president of the European Association at the October, 1959, meeting is of particular interest as this deals largely with the promotion of the use of castings.

During last year the European Conditions of Sale have been finalized which the Association accepts in principle. Mr. P. B. Higgins has represented the ABBF at the meetings of the European Committee which are held twice yearly. He has given a great deal of thought to this matter to ensure that the foundry industry is adequately represented and plays a worthy part.

Foundry Trades Exhibition

The Association was very happy to accept the offer of the organisers of a stand at the Foundry Exhibition held in Birmingham last May. The stand attracted much interest, the visitors being mostly foundrymen who were able to appreciate the castings on show. For the Exhibition the ABBF produced a *Directory of Members* and a considerable number of copies were given away.

Foundry Industries' Liaison Committee

Representatives of the Association have attended the meetings of this Committee which are held quarterly. They are also attended by representatives of the Iron, Steel, Light Alloys & Zinc Foundries Association and by the British Non-Ferrous Metals Federation. The meetings form a valuable opportunity to discuss all matters affecting the industry, both as a whole and in sectors, and enables collective action to be taken where appropriate.

Promotion of the use of Copper-alloy Castings

The Council is considering what action can be taken to promote the use of copper-alloy castings. While the merits of new materials in certain applications are recognized, the non-ferrous industry should not allow the demand for its products to decline. It is known that casting is the only means of producing certain forms in metal and that usually when there are alternative means, it is the best and cheapest method. As the product is as old as civilization, it is accepted with other familiar things without realisation of the thought, care and skill which have gone into its production; but castings are going into the glamorous new industries as well as functioning unobtrusively in the old. In an expanding economy, it is possible not only to expand their use but their uses. Are members ready to support the Association to achieve this by providing the money required and joining in a sustained effort to persuade users that attention to design, the use of the right alloy and co-operation with the foundry provides them, in the long run, with the cheapest castings and to convince them that to buy the lowest price casting, irrespective of quality, does the buyer and us no good. Mr. Buxton is engaged on a preliminary survey of this subject and I appreciate very much what he is doing.

Strength of the Association

An enquiry from the Registrar of Restrictive Trading Agreements, following which it is hoped our Association's conditions of sale may be removed from the Register, has revealed that sales of castings by member-firms total some £11,000,000 per annum to which should be added the important production of members who are tied foundries.

This information is very interesting and shows that the Association which is the only national organization of purely engineering bronze and brass founders, does represent an important sector of industry. It is greatly regretted that statistics are not available from Government sources of the number of firms in the industry, the value of their sales, the tonnage of their output or the numbers employed. This is in contrast with statistics which other countries can produce. It is, therefore, not possible to say what percentage of the industry supports the Association, but it is accepted that the Association speaks effectively for the industry as a whole.

Membership

The Association has lost several members—too many—during the year and this seems to be the result of the severe competition experienced due to the low level of trade last year. It is regrettable that firms in these circumstances economize on their subscriptions to their national trade organizations which do things firms cannot do for themselves. To withdraw support is, I suggest, short sighted. To-day more than ever it is impossible to

live in isolation and it is essential that firms in an industry should be joined together for purposes affecting their industry as a whole.

Duty on Electrolytic Manganese Metal

There is provision for an import duty of 33⅓ per cent. on this metal which has been in abeyance for some time but which the Association has been advised the Board of Trade proposes to reintroduce. Along with other interested organizations, the ABBF has opposed the reintroduction of the duty and have had it postponed. It is hoped that the duty will be removed altogether in course of time.

Duty on Imports to Southern Rhodesia

The Association has recently objected to the request made to the Government of Southern Rhodesia by a local firm that the import duty on bronze sticks and bushes should be increased by 20 per cent. *ad valorem.*

The president concluded his report by expressing his thanks to the technical committee and sub-committees, and particularly to his vice-president, Mr. W. R. Buxton, for deputizing on a number of occasions during the past year. He also thanked the secretaries for their assiduous attention to the affairs of the Association.

* * * *

The next item was the report of the Association's Technical Committee, presented by the chairman, Mr. R. Lancaster. (This report will be printed in the JOURNAL very shortly.) The Technical Committee's report finished the business of the general meeting and the president after its conclusion continued with the agenda of the annual meeting.

ANNUAL MEETING

The formal business of the annual meeting was disposed of and Mr. Brown then proposed the adoption of accounts (which had been circulated) the proposition being seconded by Mr. J. C. Sheckell and agreed. Next, on the proposition of Mr. E. Ayres, it was agreed to ask Mr. Brown to continue as president of the Association for a further year, and likewise, on the proposition of Mr. Brown, Mr. Buxton was re-elected vice-president. The remaining officers of the Association were re-elected or elected as tabulated in what follows. The opportunity is taken of recording the whole of the constitution as a tribute to the public spiritedness of the individual members and their companies.

AS TRUSTEES: Mr. W. S. Lawson, Mr. G. T. Hyslop and the secretaries, Heathcote and Coleman).

AS COUNCIL (in addition to *ex-officio* members *i.e.*, Mr. A. J. N. Brown, president, Mr. W. R. Buxton, vice-president, and Mr. R. Lancaster, chairman, Technical Committee):

Mr. E. Ayres	Millspaugh, Limited.
Mr. W. A. Bannister	C. & L. Hill, Limited.
Mr. W. R. Blakeborough, J.P.	J. Blakeborough & Sons, Limited.
Mr. E. J. Brooke	Aluminium Bronze Company, Limited.
Mr. F. G. Burgess	George Kent, Limited.
Mr. F. G. Burrell, O.B.E. ...	Shipham & Company, Limited.
Mr. G. H. Charsley	Trent Foundries, Limited.
Mr. S. L. Finch	Weir Foundries, Limited.
Mr. W. T. Hobkirk, J.P. ...	J. Hobkirk Sons & Company, Limited.
Mr. G. T. Hyslop	Phosphor Bronze Company, Limited.
Mr. W. S. Lawson	Worthington-Simpson, Limited.
Mr. W. R. Marsland	Charles Carr, Limited.
Mr. J. J. Mundell	Knowsley Cast Metal Company, Limited.
Mr. J. C. Sheckell	Billington & Newton, Limited.
Mr. C. E. Lovelace	Phosphor Bronze Company, Limited.
Mr. A. P. Wright	T. M. Birkett, Billington & Newton, Limited.

TECHNICAL COMMITTEE (in addition to *ex-officio* members, *i.e.*, Mr. R. Lancaster, chairman, Mr. A. J. N. Brown, president, and Mr. W. R. Buxton):

Mr. G. T. Callis	Manganese Bronze & Brass Company, Limited.
Mr. P. B. Cross	Aluminium Bronze Company, Limited.
Mr. R. W. Eade	J. Stone & Company (Charlton), Limited.
Sir Thomas, Ferens, C.B.E.	Shipham & Company, Limited.
Mr. G. L. Harbach ...	Worthington-Simpson, Limited.
Mr. B. R. Higgins ...	Yorkshire Engineering Supplies, Limited.
Mr. C. McNair	Millspaugh, Limited.
Mr. N. D. G. Robertson	Non-Ferrous Die-Casting Company, Limited.
Mr. H. T. Rutter	Sagar-Richards, Limited.
Mr. G. Swinyard	Phosphor Bronze Company, Limited.
Mr. A. L. Wakeling ...	Bull's Metal & Marine, Limited.
Mr. A. Wilkinson	Anti-Attrition Metal Company, Limited.
Mr. A. P. Wright	T. M. Birkett, Billington & Newton, Limited.
Mr. E. Wallace	Dewrance & Company, Limited.
Mr. F. Hudson	Mond Nickel Company, Limited.
Mr. E. F. Hodges	Knowsley Cast Metal Company, Limited.
Mr. A. W. O. Webb ...	J. Stone & Co. (Propellers), Limited.

CO-OPTED MEMBERS

Mr. G. W. Brown	Institute of British Foundrymen.
Mr. F. C. Evans	John Miles & Partners (London), Limited.
Mr. E. C. Mantle	British Non-Ferrous Metals Research Association.
Mr. W. W. Glick	British Non-Ferrous Metals Research Association.

PUBLICITY COMMITTEE:

Mr. W. A. Bannister ...	Chairman.
Mr. E. J. Brooke	Aluminium Bronze Company, Limited.
Mr. W. R. Buxton	Eyre Smelting Company, Limited.
Mr. A. P. Wright	T. M. Birkett, Billington & Newton, Limited.

COST COMMITEE:

Mr. G. H. Charsley	Chairman.
Mr. W. H. Davies	(Consultant).
Mr. W. Jones	C. & L. Hill, Limited.
Mr. J. C. Sheckell	Billington & Newton, Limited.

RECRUITMENT AND TRAINING COMMITTEE:

Mr. E. Ayres.
Mr. G. H. Charsley.
As EDITOR of the Association's *Bulletin*, Mr. W. R. Buxton.

Also elected or re-elected were the Association's representatives on a large number of other bodies including:

The European Committee of Foundry Associations.
National Foundry College Board of Governors.
Committees of the British Standards Institution.
Institute of British Foundrymen.
Governmental Advisory Committee (Die-Castings) and Technical Panel.
Scrap Advisory Committee.
Foundry Recruitment and Training Committees.
Ministry of Labour & National Service Joint Standing Committee.

The auditors, Kemp Chatteris & Company, were re-elected as were also the secretaries, Heathcote and Coleman.

A vote of thanks to the chairman was then proposed by Mr. T. Wright (Russell's Brassfoundry, Limited), and accorded with acclamation.

Equipment and Supplies

Vibrating Screens

Armstrong Whitworth (Metal Industries), Limited, Close Works, Gateshead 8, are to manufacture under licence Overstrom vibrating screens, from the USA. The screens are built for all types of service, and come in seven sizes ranging from 3 by 18 in. to 16 by 6 ft. Each can be equipped with one, two or three decks, and all can be fitted with partial or complete dustproof enclosures, water-spray equipment, and heating units which are sometimes required for the finer-mesh decks dealing with damp, sticky materials.

No eccentric mechanism is involved to produce the rocking action. Vibration is set up by having unbalanced flywheels mounted at the ends of a plain shaft in the vibrator unit which is fixed rigidly on the screen box. No counterbalancing is necessary to prevent transmission of vibration to the supporting structure, and it is claimed that undesirable side-swaying motion is entirely eliminated by the use of involute springs of high strength and low stiffness. Substantial stripping of the supporting structure is unnecessary when replacing screen cloths. Patented stretcher-bar lifting-springs automatically disengage the bar from the hooked edge of the screen cloth when exterior tension bolts are loosened, and the cloth can then be withdrawn. Oil is used for the lubrication of the vibrator unit, thus reducing the power necessary for operation with grease-packed units, and also allowing quicker starting in cold weather.

Automatic Warehousing

Solartron Electronic Group, Limited, and John Brown & Company, Limited, have formed a jointly-owned company, Solartron-John Brown Automation, to exploit the Gumpertz automatic warehouse system, the first installation of which has been in satisfactory full-time operation for two years in the USA.

With this new system, instead of the conventional bins and shelving, the warehouse is fitted out with banks of steeply slanting shelves, one behind the other in rows. Each shelf, which can rise to the height of many feet, carries a single layer of one component or package. At the lower end of each shelf is a barrier which prevents the products sliding. This barrier, when electro-mechanically actuated, allows a single or any required number of packages or articles to drop onto an endless belt. A number of these belts feed a main conveyor belt, which in turn delivers to the despatch or utilization department, as the case may be. This system might possibly be of use in the storage and despatch of small mass-produced castings.

Flue-gas Treatment

Literature received from Dust Control Processes, Limited, 161, Clarence Street, Kingston-upon-Thames, describes a new method of suppressing corrosive flue gases and oily smuts discharged from oil-fired and solid-fuel-fired furnaces, boiler installations, etc. The system, known as the D.C.P. Insufflator, has been developed to facilitate the introduction into the flue gases of some 100 million particles per cub. ft. of a finely-divided alkaline, hygroscopic precipitate (D.C.P. 58 sulpho-neutralizer) at such a rate that it will ensure the intimate mixing of the particles of powder and the gases. The agglomerated particles are then extracted from the gas stream by a Turbocell dust-collector. No dimensions are quoted of this apparatus, but from an illustration one model would appear to be about 2 to 3 ft. high and about 20 to 24-in. dia.

Oxygen-cutting Rig

A new heavy-duty oxygen-cutting rig for steel castings up to 5 ft. thick has been developed by British Oxygen Gases, Limited, Spencer House, St. James's, London, S.W.1. This unit incorporates the company's latest nozzle-mixing blowpipe, using propane as the fuel gas, and apart from providing industry with a means of cutting greater thicknesses, it is claimed that it improves the ease of cutting, safety and quality of finish. The cutter is particularly suitable for removing feeders from castings, as well as for breaking up ladle bottoms and other scrap material for re-melting or disposal. With this new equipment, it is claimed that a 50-in. feeder in low-carbon cast steel can be removed at approximately 2 in. per min., using only about 60 lb. per hr. of propane and 8,000 cub. ft. per hr. of oxygen.

Electric Winch: Felco Hoists, Limited, 29, Cromwell Road, South Kensington, London, S.W, have introduced a new range of electric-powered winches. Available in capacities from 2 to 12 tons, these units are of all steel construction, and have no bed-plate or platform. All parts of the winch mechanism are fully enclosed, the absence of exposed parts making the equipment weatherproof, and the gears run in oil baths and are mounted on ball-bearings. An interesting feature is the electro-hydraulic main brake, which is in addition to an auxiliary foot-brake for controlling the load when operating the winch in the drum-idling position.

Pocket Microscope: Ellis Optical Company, 5, Beeches Avenue, Carshalton, Surrey, have designed and produced a high-powered pocket microscope, little bigger than the average fountain pen, which has optically-worked lenses and a magnifying power of from 20 to 40 times. Named the Elliscope, the unit has a mirror at the base which, when turned towards a light source, reflects light on to the object to be examined. Magnification is controlled by a sliding tube, and correct focusing obtained by adjusting a knurled ring. The field of observation is a circle of approximately ½ in.

Drying Equipment: Foundry & Metallurgical Equipment Company, Limited, Queens Road, Weybridge, Surrey, have made arrangements with Benno Schilde A.G. of Bad Hersfeld, Germany, to manufacture and market in Great Britain and Ireland, drying equipment operating on the Benno Schilde system. This equipment includes uniflow-type gas and oil-fired sand-dryers of 1 to 10-ton per hr. capacity, gas and oil-fired portable mould-dryers, and batch and continuous core- and mould-drying stoves.

FIFTEEN JUNIOR EMPLOYEES of the Staveley Iron & Chemical Company, Limited, of Chesterfield, left on April 24 on an eight-day continental tour of ironworks and factories in Holland and Belgium. The company is paying for the tours, and the employees will also receive their full week's pay.

A CHAIR OF ELECTRICAL ENGINEERING is to be founded at Edinburgh University. It is expected that an appointment will be made in time for the opening of the new university session in October. A refrigeration test unit has been donated to the university by L. Sterne & Company, Limited, Glasgow, and a centrifugal pump set unit has been given by the Harland Engineering Company, Limited, Alloa.

New Spectroscopic Standard Samples established in the US

The US National Bureau of Standards has recently established a set of eight new standard samples of ingot iron and low-alloy steel. Analysed and certified for 17 elements, these standard samples are designed for control of composition in the iron and steel industry where the spectroscope or spectrography is employed.

Samples in Disc Form

The new samples are the first spectroscopic standards which the Bureau has certified for carbon and phosphorus. These two elements can now be determined spectroscopically, thus increasing the speed and efficiency of the complete analysis. The samples are also the first to be issued in disc form, in addition to the usual rod ($\frac{7}{32}$ in. in dia. and 4 in. long). The new disc ($1\frac{1}{4}$ in. dia. and $\frac{3}{4}$ in. thick) is suitable for X-ray fluorescence analysis as well as optical-emission spectroscopy.

In combination with other samples already available from the Bureau, this set of standards provides certified concentration values for determining most of the elements encountered in the analysis of iron and low-alloy steel. Certification has been made for the following elements: carbon, manganese, phosphorus, silicon, copper, nickel, chromium, vanadium, molybdenum, tin, titanium, boron, arsenic, tungsten, zirconium, niobium and tantalum (see Table 1). Several additional elements may be certified later.

Production Method

Before the samples were prepared, the melting, casting, fabricating and testing procedures were investigated to ensure proper graduation of concentration ranges and high homogeneity in the final product. For each standard the material was prepared by: melting in a one-ton induction furnace, removing excess gases, adding alloying elements and introducing rare earths as a possible aid to homogeneity. Then the material was processed by: forging the ingots into slabs, discarding portions of questionable homogeneity, hot-rolling selected material to oversize rods, annealing and centreless grinding to size.

The standards can be applied directly to the analysis of steel rods and discs prepared in a similar manner and with similar dimensions. However, if they are applied to the analysis of steel samples prepared by different methods, adjustments may be required to correct deviations caused by physical differences.

TABLE 1.—*Ingot Iron and Low-alloy Steel Standards for Spectroscopic Analysis.*

NBS No.*	461 1,161	462 1,162	463 1,163	464 1,164	465 1,165	466 1,166	467 1,167	468 1,168
Designation.	Low-alloy Steel A	Low-alloy Steel B	Low-alloy Steel C	Low-alloy Steel D	Ingot Iron E	Ingot Iron F	Low-alloy Steel G	Low-alloy Steel H
Element.	Per cent.							
Carbon	0.15	0.40	0.19	0.54	0.037	0.065	0.11	0.26
Manganese	0.36	0.94	1.15	1.32	0.032	0.113	0.275	0.47
Phosphorus	0.053	0.045	0.031	0.017	0.008	0.012	0.035	0.023
Silicon	0.047	0.28	0.41	0.48	0.029	0.025	0.26	0.075
Copper	0.34	0.20	0.47	0.094	0.019	0.033	0.067	0.26
Nickel	1.73	0.70	0.39	0.135	0.026	0.051	0.088	1.03
Chromium	0.13	0.74	0.26	0.078	0.004	0.011	0.036	0.54
Vanadium	0.024	0.058	0.10	0.295	0.002	0.007	0.041	0.17
Molybdenum	0.30	0.080	0.12	0.029	0.005	0.011	0.021	—
Tin	0.022	0.066	0.013	0.043	0.001	0.005	0.10	0.009
Titanium	—†	0.037	0.010	0.004	0.20	0.057	0.26	0.011
Boron	0.0002	0.0005	0.0012	—	0.0001	—	—	—
Arsenic	—	0.046	0.10	0.018	0.010	0.014	—	0.008
Tungsten	0.012	0.053	0.105	0.022	—	—	0.20	0.077
Zirconium	—	0.063	—	0.010	—	—	0.094	—
Niobium	0.011	0.096	0.195	0.037	—	—	0.29	—
Tantalum	0.002	0.036	0.15	—	0.001	—	0.23	—

* 400 series, rods $\frac{7}{32}$ in. dia. and 4 in. long; 1100 series, discs $1\frac{1}{4}$ in. dia. and $\frac{3}{4}$ in. thick.
† Dashes indicate elements not certified for spectroscopic analysis.

A NEW RANGE of underfloor-engined passenger-chassis, known as the Royal Tiger Cub range, is announced by Leyland Motors Limited. So far only preliminary details of the new range are available. They show that the range consists of four models, each with an unladen weight of aproximately 4 tons 16 cwt. and a maximum laden weight of 13 tons. They fill a gap in the firm's passenger range between the lighter 9-ton "Tiger Cub" and 11-ton "Leopard" and the heavier $13\frac{1}{4}$ to 15-ton "Worldmaster" chassis, and are designed for operation on European-type metalled roads.

THE CORNERSTONE of a new plant in Algeria for Régie Renault was recently laid. Construction will take about 18 months and on completion the plant will provide for production of 50 Dauphine cars per day.

THE NORTH STAFFORDSHIRE CHAMBER OF COMMERCE is holding a Golden Jubilee Industrial Exhibition at Hanley Park, Stoke-on-Trent, Staffs, from May 18 to June 4. Samples of precision-machined parts, non-ferrous and high-duty castings will be shown by T. M. Birkett, Billington & Newton, Limited, of Hanley Park and Longport, Stoke-on-Trent, on stand No. 41.

"Too Easy" for Young People?

At a meeting of the Council of Bradford Chamber of Commerce, the president, Mr. D. W. M. Scott, asked members for their views on a letter from the Yorkshire Council for Further Education stating that they were in complete sympathy with the Crowther Report that no one under 18 years of age should be expected to rely solely on evening classes for further education. It was felt that to continue evening-only courses was wasteful, uneconomic and educationally inefficient, and support was asked for a recommendation of local education authorities in the Yorkshire region that evening-only courses for persons of 18 and under should lapse during the next two years or so, except where they formed part of day-release courses.

Mr. F. S. Summers, president of the Bradford Engineering Employers' Federation, pointed out that engineering employers had given day release to many pupils for years and suggested that the Yorkshire Council was rather asking for something like a blank cheque. The larger engineering concerns were the proper schools for apprentices from 15 to 17 years of age, and day release would interfere with their proper training there. He commented that educationalists seemed to want to re-introduce half-time working. Mr. G. Phillips declared that employers were opposed to the complete lapse of evening classes. They needed recruits, but by lapsing evening classes and substituting day-release classes they would be presenting young people with everything on a plate, and creating for themselves a psychological problem to be dealt with later.

Sir Kenneth Parkinson, expressing agreement, said the Yorkshire Council's proposals would not necessarily be fair to young people, because obviously no employer could release all his young people to attend day classes and it would surely penalise any who were not selected or permitted to attend them from doing so on their own initiative. Mr. John L. Hanson declared that any young man who genuinely wanted to learn could do so by attending evening classes, but if those classes were lapsed there would be a tendency for a boy to attend classes during the day at his employers' expense and not, perhaps, turn out in the evening. He added: "I think that if we are not careful we shall make it much too easy for these young people."

On the suggestion of the president, it was agreed that a reply should be sent to the Yorkshire Council expressing the opinion that their proposals were far too sweeping and could not be supported in their present form.

Mechanical Handling Federation

The eighth annual general meeting of the *Fédération Européenne de la Manutention* (*FEM*, Mechanical Handling Federation) will be held in Stockholm, Sweden, from June 27 to July 2. The federation embraces manufacturers of all types of mechanical handling equipment from the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Italy, Netherlands, Spain, Sweden, and Switzerland, all represented by their national committees. The general meeting will be concluded by a general assembly of the *Fédération* during which the work of the various sections will be reviewed and co-ordinated, and problems will be examined. Finally, there will be a banquet organized by the Swedish national committee. More than 250 delegates have already indicated that they will attend. The Federation has its headquarters and permanent secretariat in Paris, at 10, Avenue Hoche.

International Nickel Changes

Mr. H. S. Wingate, president of the International Nickel Company of Canada, Limited, since 1954, and a director since 1942, has been elected chairman of the board and chief officer of the company. Mr. J. R. Gordon has been elected president of the company, succeeding Mr. Wingate. Mr. Gordon has been executive vice-president since 1957, and a director since 1953. Mr. R. D. Parker, a director since 1957, and vice-president in charge of Canadian operations since 1955, was elected senior vice-president of the company. Mr. Wingate succeeds Dr. J. F. Thompson, who retires as chairman after having served the company for 53 years, and as chairman of the board and chief officer since 1951. Dr. Thompson becomes honorary chairman and will continue to serve as chairman of the executive committee.

The directors' meeting, which was the first to be held in Manitoba, presages the opening early in 1961 of Inco's new nickel project 400 miles north of Winnipeg. The meeting came at the conclusion of a tour by directors of the mine and facilities and the town of Thompson, that followed the annual shareholders meeting held in Toronto on April 27. At that meeting Dr. Thompson announced that net earnings by Inco for the first quarter of this year will be "significantly higher" than the $16,900,000 reported for the first quarter of 1959. Nickel deliveries in March tapered off slightly from the extraordinarily high levels of the first two months, but the rate of deliveries for the quarter was greater than production.

Demand for nickel is expected to remain strong throughout the current year, though, unlike the pattern of earlier post-war years, potential world supply is now more than adequate. Dr. Thompson believes that the current expansion in nickel use should continue.

The board of directors of the company's United States' subsidiary, International Nickel Company, Inc., also met at Thompson and elected Mr. Wingate chairman, Mr. Gordon, president, and Dr. Thompson, honorary chairman and chairman of the executive committee of that company.

Sheffield's "Apprentice of the Year"

David G. H. Garnett, 20-year-old patternmaker at the Rotherham works of the Steel, Peech & Tozer branch of the United Steel Companies, Limited, was selected as Sheffield's "Apprentice of the Year" at the Cutlers' Hall, Sheffield, on April 28. He was chosen from six finalists by a panel of three judges. His selection will enable him to visit Stockholm on an educational tour for a fortnight from May 26. David Garnett is a former student of Rotherham Technical College and has already visited industries in Italy, Germany, France and Sweden.

The contest was organized by Sheffield Junior Chamber of Commerce, and the panel of judges was Mr. P. G. Hoare, senior vice-president of Sheffield Chamber of Commerce, Mr. R. S. Bruce, president of Sheffield Chamber of Commerce, and Mr. G. W. Brand, Sheffield Youth Employment Officer.

Three apprentices from Steel, Peech & Tozer, Michael J. Kite, John T. Wright and John W. Muffin, together with Brian Whittington, patternmaker, Firth-Vickers, Limited, and Martin L. Cliffe, production engineering student, Laycock Engineering Company, Limited, were the other finalists.

Mr. J. F. BENNETT has been appointed treasurer of the Esso Petroleum Company, Limited.

SECTION DEVOTED TO THE TECHNOLOGY OF PRODUCING DIMENSIONALLY-ACCURATE CASTINGS

Investment Casting at Renault*

By M. Marinier

The examples to be discussed are taken from the working range of the investment foundry of the French National Renault Works. This foundry, "tied" to the motor-car works, produces approximately 90 per cent. of its output as mass-produced motor-car parts and 10 per cent. of its output for jig and tool castings in series of from 10 to 1,500 castings off. It would not be correct to describe this foundry as a "lost-wax-process foundry" or as a "precision foundry," because (1) all patterns are made from commercial polystyrene, and (2) no close tolerances are particularly required common to the whole production programme. The aim in view is the production of castings at a lower cost than is possible by any other method (cost being defined as cost of the finished machined casting.) This objective has been achieved by using the method to be described, and by taking special precautions at different stages of the production. The purpose of this paper is to present some of the observations made concerning improvements in the precision of the patterns.

In an investment foundry, there are only three possible ways to establish dimensions in the course of production: (1) to measure the initial die impression; (2) to measure the patterns obtained from this die, and (3) to measure the actual castings resulting from the patterns. Considering Fig. 1 it is clear

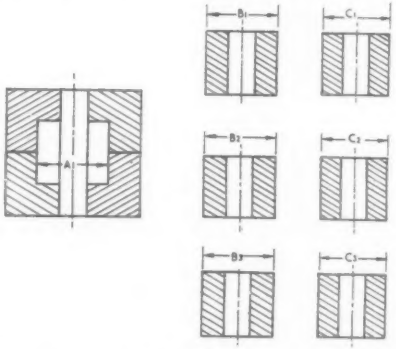


FIG. 1.—*Diagram illustrating the three sources of dimensional error when making investment castings: A the pattern die; B the patterns, and C the castings.*

that the actual dimensions of the different patterns, B_1, B_2, B_3 . . . obtained from the same die A, show a certain dispersion when compared with nominal dimensions. Similarly, the actual dimensions of the different castings C_1, C_2, C_3 . . . obtained from the patterns B_1, B_2, B_3 . . . show another range of dispersion. Statistical control can supply figures which illustrate the actual range of dimensional inaccuracies, and this information will enable the foundryman to find means for reducing dimensional variations and as a result he can take action on such factors of production as he can control.

This paper is not intended to demonstrate the effects of factors which influence the dimensions when passing from the stage of the original die, A, to that of pattern, B. In passing, however, it can be said that these factors are less numerous and better known than those which intervene between the stage of pattern, B, and that of the final casting, C.

DIMENSIONS OF THE DIE

Dimensional accuracy of the die is a most important factor.

Small-scale Production

If small numbers off are required, generally a wooden pattern is produced (Fig. 2), which, in turn, is used to produce a die by casting a low-melting-point, contraction-free alloy or a special resin around the aluminium master-pattern. Having cast this pattern-die, one can now proceed to inject into it polystyrene plastic pattern-material under pressure, using a very simple machine. By this method final patterns for moulding are obtained. Master patterns of aluminium, steel or gunmetal have to be carefully finished or even partly or fully machined, according to circumstances, because the dimensions of the mould to be cast around the master pattern depend on their accuracy. Although suppliers guarantee that the low-melting-alloy or the resin to be cast around the master-pattern are both "free from

* Translated by Dr. O. P. Einerl from a paper presented at the Paris Congress of the European Investment Casters Association.

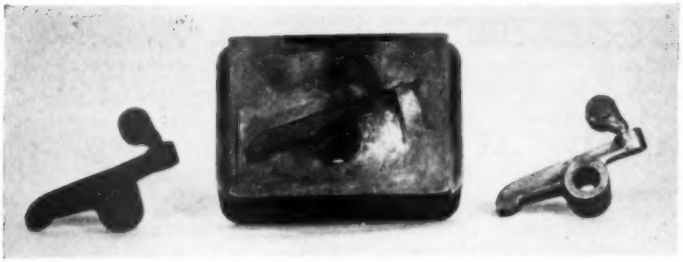


FIG. 2.—*(left) Wooden pattern; (right) aluminium master-pattern; (centre) finished die-equipment which is capable of producing up to* 1,500 *castings.*

contraction," it is a fact that a certain amount of contraction will always occur. It is therefore necessary to take account of this when deciding the nominal dimensions of the master-pattern. Insufficient checking is one of the main causes of dimensional errors and unfortunately these often come to light only when the parts are finished.

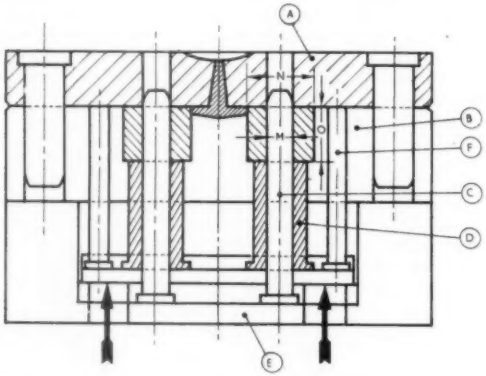


FIG. 3.—*Schematic layout of a pattern-die for a ring casting, showing the various components (the accuracy limitations of which are explained in the text).*

Large-scale Production

For mass-production, metal dies are produced and these are generally machined all over. Polystyrene is injected into these dies by means of automatic machines as supplied by the foundry-equipment industry. Fig. 3 shows schematically the metallic die for a ring casting, where the injection channel runs right through the half die, A. The half die, B, contains the fixed core, C, and a movable ejector, D, which slides over the core in order to eject the pattern from the die after this has been opened. Checking of the mould die during the course of its production will influence the following nominal dimensions: (1) The diameter of the core, the accuracy of which is relatively easy to ensure; (2) the outside diameter of the ring, which is much more difficult to achieve correctly, and (3) the height, O, of the ring, which is the most difficult of all to obtain accurately, because the accuracy depends on the distance of two mobile parts: the half-die, A, and the ejector, D.

Difficulties

In order to ensure, during the course of the production of the ring, that the distance, O, remains as constant as possible, it is necessary to make certain that the ejector, D, is in close contact with the base, E; that is to say, that no foreign particle should be allowed to be present between D and E. It may happen sometimes that a deformation of the ejector, D, occurs, despite the fact that the column, F, returns the ejector into its place when the die is closed and although the two half parts A, and B, remain in close contact.

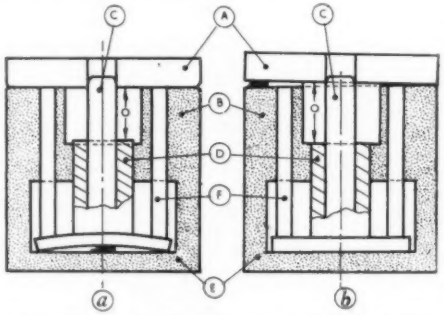


FIG. 4.—*Views of the same die as shown in Fig.* 3, *but indicating how dimensional errors of patterns can result from deformation or misplacement of components of the die.*

Fig. 4(*a*) shows, in an exaggerated way, an incorrect position of ejector, D, which is not visible from outside the die. It is also necessary to check whether the half-die, A, is in perfect contact with the half-die, B, and Fig. 4 (*b*) shows a faulty closing of the die. These are the most common defects which concern the impression itself; they are faults which are transferred to the pattern from the various dimensional locations.

Machining Accuracy

In order better to demonstrate the improvement obtained by machining as regards the accuracy of dimensional points mentioned in the first two sections of the paper, a graph, Fig. 5, has been prepared in which the dimensional points, measured on a die with multiple impressions, have been laid out. On the axis of abscissæ the various categories of dimensions have been indicated, and the number of measurements of each group of tests are shown on the ordinates. It is clear that the dis-

persion of actual figures for dimensions of type M is less than 0.0002 in., whereas the total dispersion of measured dimensions for type N is more than 0.001 in. The deviation from nominal dimensions for type O, taken between two movable

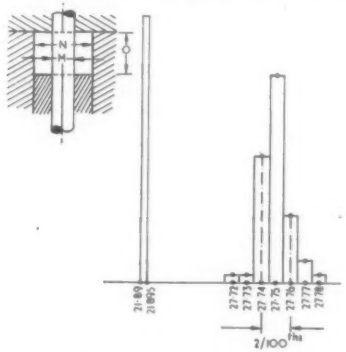


FIG. 5.—*Graph of results obtained by measuring items produced from a multi-impression die. Ninety per cent. of the pieces surveyed were within 0.0008 in.; type M dimensions required exterior correction, type N needed internal reaming, and dimensions of type O varied much according to the effect of wear of moving die-parts.*

parts, can amount to as much as 0.004 in. when the die has produced a large number of patterns and already shows marks of wear on the movable parts.

FILLING OF THE DIE CAVITY

Returning to the example of the ring, and by studying the defects which, independent from the

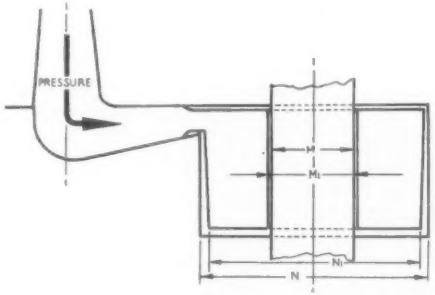


FIG. 6.—*Sketch of the ring die, indicating dimensional variations which may occur.*

die-cavity, may alter the dimensions of a pattern in wax or in plastic material injected into the cavity (generally under pressure), faults may be found in the following dimensions: (see Fig. 6).

Dimensions

The inside dimension, M_1, of the pattern is generally very close to that of the core M, as a result of the contraction of the material, which tends to move in the direction of the core. The outside dimension, N_1, of the pattern is often smaller than the dimension N of the cavity because filling is insufficient. To remedy this, it is necessary to bring such quantities of material into the impression as may be necessary to compensate for the reduction of volume caused by contraction, and to continue to do so until solidification is complete. Modern injection machines maintain the pressure during a sufficiently long and controllable time, but the mould may resist the transmission of this pressure, and the feed channel, if too narrow, may solidify before the casting.

Fig. 7 (*a*) shows, after a given time, the state of solidification of the ingate and of the pattern which would tend to prevent the entry of addi-

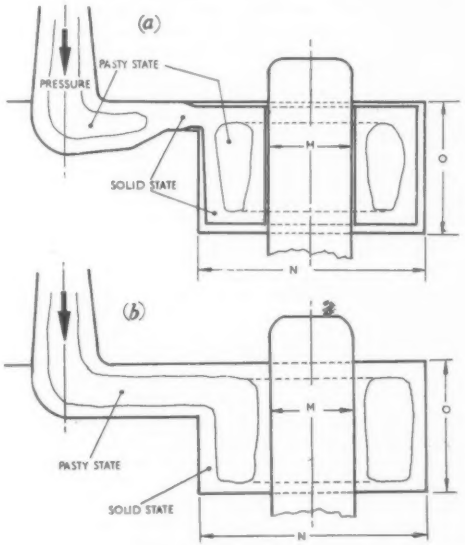


FIG. 7.—*Two examples of the influence of injection-orifice size and feed pressure. In (a), premature solidification of the pattern material at the orifice prevents "feeding" of the body of the pattern; in (b), the enlarged inlet permits the full utilization of feed material and pressure.*

tional material required to fill the total volume of the impression. Fig. 7 (*b*) shows, after the same time, the state of solidification of ingate and of pattern in a case where the cross-sections are such that continuity of flow exists, in addition to transmission of effective pressure from the injection nozzle to the interior of the pattern, so that its contraction is compensated by the influx of hot material. This action can be so effective that it has been found on occasions impossible to withdraw a pattern from the die, because its contact with the walls of the die was so perfect.

The Renault concern are forced to regulate their

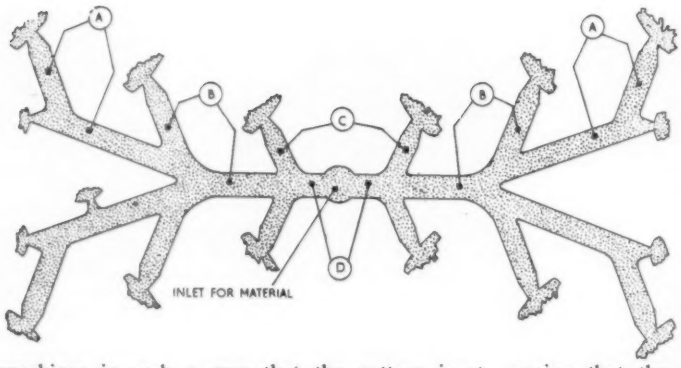


FIG. 8.—*Example of an ingate system for a multiple-impression die, the following dimensions being the respective cross-sectional areas:* A = 45 mm.² (0.07 sq. in.); B = 39 mm.² (0.06 sq. in.); C = 26 mm.² (0.04), and D = 32 mm.² (0.05 sq. in.).

machines in such a way that the pattern is at least 0.0004 in. smaller than the cavity, in order to withdraw the pattern without accidents in the normal course of industrial practice. When multiple impressions are used for mass-production, identical filling of all impressions has to be achieved. In order to ensure that the pressure is transmitted on all these impressions, the cross-section of the ingate has to be made larger the further it is away from the injection nozzle. The cooling caused by the length of the run through the ingate is then compensated by a greater volume of hot material.

Spray Runners

Fig. 8 shows an example of multiple non-radiating feeding. Sections (A), (B) and (C) have surfaces which expand so well that the patterns on the extreme ends have dimensions strictly identical with those in the centre. For similar reasons, it is necesary to avoid the frequent mistake of cooling the die in the region adjacent to the main inlet gate, from the nozzle of the machine onwards. On the contrary, it is necessary to cool the liquid material from the outer regions of the group of impressions. Fig. 9 is a photograph of a spray of 12 patterns produced under these conditions at the rate of 80 sprays or 960 items per hour.

Dimensions at Right Angles to the Die Joint

It has been shown previously that dimensions at right angles to the die joint are already affected by any faults connected with the cavity itself. Supposing that the adjustment of the machine, the cross-sections of the ingates and the cooling of the mould were correct, the dispersion of the pattern dimensions encountered would still be much more pronounced than, for instance, the dispersion of dimensions measured on the inside diameter.

Summarizing: it is possible in mass-production to maintain throughout the following tolerances on polystyrene patterns injected into the multiple dies: plus or minus 0.0008 in. on interior dimensions; plus or minus 0.0016 in. on outside dimensions, and plus or minus 0.004 in. on dimensions at right angles to the mould joint.

CONCLUSIONS

The facts mentioned in the paper confirm the observations made by numerous specialists. To obtain close tolerances is, in the first instance, a function of the precision of the die cavities and of the quality of the filling which produces the pattern. The operations of moulding and casting which follow, mostly only cause very localized deformations, and the dispersion of the dimensions found on castings in addition to such faults does not exceed that of the dimensions of the pattern. In the majority of cases, the small local deformations do not cause any trouble in the functioning of the casting. If a deformation should prove objectionable, it is necessary to provide for machining of the surface where such deformation occurs. This operation will be much less costly than an effort to obtain, at no matter what price, a correct surface "as cast."

These observations have opened the way for a new market for investment castings, *i.e.*, the production of small engineering parts requiring little

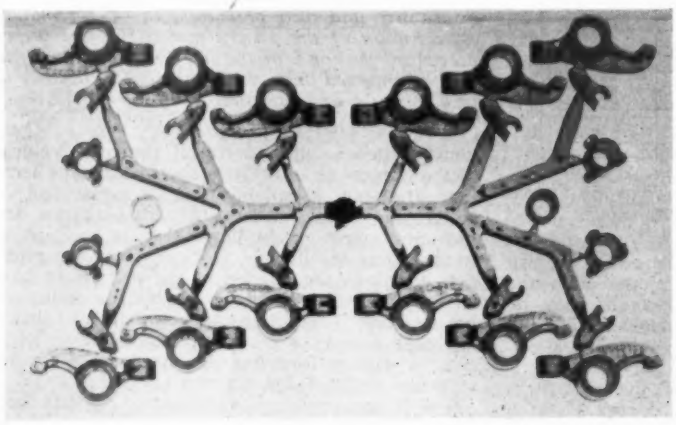


FIG. 9.—*Spray of* 12 *patterns produced under conditions of controlled cooling, at the rate of* 80 *per hour.*

machining, or suitable in the "as-cast" condition for proper functioning, with tolerances of 0.008 to 0.012 in. easily obtainable for the whole output.

The Renault foundry produces in mass-production quantities by this method castings of a quality equivalent to that of forged components but at a much lower cost, thanks to the application of the new process, which is characterized by the following stipulations: (*a*) Use of polystyrene patterns, which can be produced and assembled very quickly; (*b*) boxless moulding, thus avoiding costly moulding boxes, and (*c*) continuous drying operations, entailing the removal of patterns and preheating of moulds in greatly reduced times.

This successful development of a production method shows that the domain of the investment foundry is not limited to the production of small, difficult-shaped castings of high accuracy—a process which must demand high prices in order to be economic for the foundry. The results described have been achieved at the Régie Nationale Renault in the course of investigations carried out by scientific research, encouraged by Mr. Pomey (and brought to life by the co-operation of the management of foundries and forges, under the direction of Mr. Perchat) with a team combining the research engineers, the foundry methods-department, the sand and refractory laboratory and the production departments.

The author expresses thanks to the general manager of the Régie Renault for his permission to publish this paper, and to the president of the firm for his interest.

* * *

DISCUSSION

When the paper was discussed at the conference, MR. MERMILLOD asked which types of castings were produced by this concern.

MR. MARINIER replied that the greater part was from 0 to 40 gm. (up to 1½ oz.) with a maximum length of 5 cm. (2 in.).

MR. MEERKAMP VAN EMDEN asked whether the polystyrene models were used as they came from the plastic press, with their polystyrene sprues, or if they cut from the sprues and assembled in clusters.

THE AUTHOR replied that the latter was the case—the polystyrene sprues were necessary to obtain good models, but of no use for assembling patterns in clusters.

BICTA's Second Annual Conference

The second annual conference of the British Investment Casters' Technical Association is to be held at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C.2, from May 16 to 18. A programme of technical sessions has been arranged and ample time will be allowed for discussion of the papers presented.

Programme

Monday, May 16

7.0 *p.m. to* 8.30 *p.m.* Members and their ladies will gather for an informal party before the Conference proper commences on the following day.

Tuesday, May 17

9.30 *a.m.* Annual general meeting (BICTA members only), during the course of which reports of the following technical committees will be presented and discussed — Metal Specification Committee, Technical Publicity Committee, Industrial Health and Safety Committee, and Industry Statistics Committee.

11.20 *a.m. to* 12.30 *p.m. Technical session No.* 1—(chairman: Mr. L. S. Taylor (G. L. Willan, Limited)): "Metallurgy of Cast 13-per-cent. Cr. Steel," by J. Beech (British Steel Castings Research Association), followed by discussion.

2.15 *to* 3.45 *p.m. Technical session No.* 2—(chairman: Mr. N. Walker (Hadfields, Limited): "Specifications and Mechanical Properties of Investment Castings," by L. S. Taylor (G. L. Willan, Limited) and A. G. Mason (Deritend Precision Castings, Limited) Following the discussion of this paper, a film will be shown on the multiple-dip shell process of K. W. Thompson (of K. W. Thompson Tool Company, New York).

4.0 *to* 5.30 *p.m. Technical session No.* 3—(chairman: Mr. G. A. Tomkinson (D. Napier & Sons, Limited)): (1) "Some Experiences with Vacuum Casting into Investment Moulds," by L. S. Taylor. (2) "Industrial Refractory Crucibles," by Dr. F. W. Haywood and F. George (Refractory Mouldings & Castings, Limited), and discussions.

7.30 *for* 8.0 *p.m.* Annual dinner (members and their ladies); dinner jackets.

Wednesday, May 18

9.30 *to* 10.30 *a.m. Technical session No.* 4—(chairman: Mr. R. W. N. Danielsen, Deritend Precision Castings, Limited): "Dimensional Aspects of Lost-wax Investment Casting," by N. Mason (Firth-Vickers Stainless Steels, Limited) followed by discussion.

10.45 *a.m. to* 12.45 *p.m. Technical session No.* 5—(chairman: Mr. W. Foyers (H. & F. Precise Castings, Limited)): (1) "Hot-tearing Problem in a Part Cast in a Low Mn/Ni/Cr/Mo Carburizing Steel," by C. Watts (director of research, Precision Metalsmiths Inc.). (2) "Investment-foundry Facilities and Processes used by Precision Metalsmiths Inc.," by L. E. Carr (manager, special projects, Precision Metalsmiths Inc.), and discussions.

12.45 *p.m.* Luncheon, followed by chairman's closing remarks and announcement of the election of the Association's new chairman.

P.G. Engineering's New Venture

Formation of Parsons Powergas, with headquarters in London, has been announced as a joint enterprise by the Ralph M. Parsons Company, engineers-constructors of Los Angeles and P.G. Engineering, Limited, a member of the UK Power-Gas group. Complete engineering and construction of petroleum, petrochemical, and related plants will be performed by Parsons Powergas, backed by the combined resources and experience of the parent companies.

Initially, activities will be concentrated in the British Commonwealth. Three men from each firm are to be appointed to a committee which will direct the new enterprise. Those from Parsons are Mr. Harry Broom and Mr. Robert V. Peaslee, vice-presidents, and Mr. Ahmet Neyzi, European operations manager. Mr. R. W. Rutherford, managing director of P.G. Engineering, is one of the British representatives, the names of the other two are to be announced shortly. Mr. Peaslee will serve as general manager of Parsons Powergas.

Investment Casting of High-hot-strength 12-per-cent. Chrome Steel*

By H. Schneider

High-chromium steels are regarded as difficult to cast, a fact which makes all the more interesting this report that investment founders can produce castings in this material which have equal mechanical properties to those of forgings. The author recommends that strict attention be paid to heat-treatment.

The high corrosion-resistance of 12-per-cent. chrome steels confers on them a wide field of application in turbine construction. The addition of

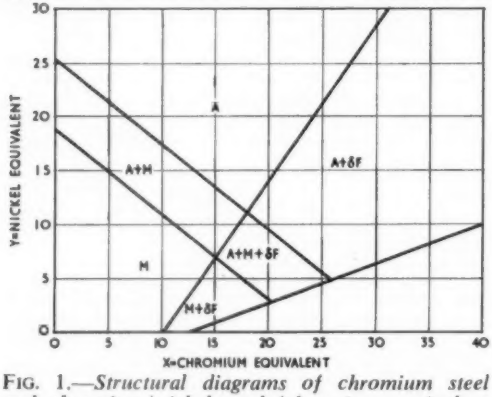


FIG. 1.—*Structural diagrams of chromium steel and chromium/nickel steel (chromium equivalent = Cr + 2 Si + 1.5 Mo + 0.5 Nb, and nickel equivalent = Ni + Co + 0.5 Mn + 30 C + 7.5 Nb.*

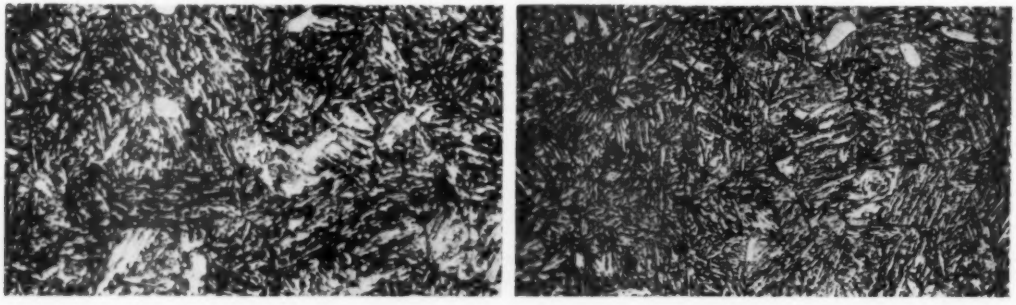
chromium alone is, however, of little importance for hot-strength, which can only be increased by additions of molybdenum, niobium, tungsten, vanadium, etc. Of these, molybdenum, tungsten and cobalt give rise to higher recrystallization temperature, and niobium, tungsten and molybdenum increase the creep-resistance properties by the formation of carbides, nitrides and intermetallic compounds in the slip planes of the crystals.

To obtain good properties in castings of these materials, it is desirable that, in principle, they show a transition structure. From the phase-diagrams of nickel/chromium steels, their structure can be deduced approximately, and Fig. 1 shows this diagram. An attempt has been made to express the influence of the various alloying elements by multiplication factors. The lines in the diagram indicate the limits of the different structures. The 12-per-cent. chrome steel is—depending upon further addition-elements present—in the purely martensitic, in the martensitic-ferritic or in the martensitic-austenitic region. The heat-resistant chrome steel used in the author's investment foundry has the following composition: C, 0.2; Cr, 12.5; Si, 0.6; Mn, 0.8; Co, 2.0; Mo, 0.8, and V, 0.3 per cent. The approximate equations are:—Chromium equivalent = Cr+2 Si+1.5 Mo+5 V, and nickel equivalent = Ni + Co + 0.5 Mn + 30 C.

When calculated for the alloy of the composition detailed, these give a steel with a chromium equivalent of 16.4 and a nickel equivalent of 8.4 in the Scheffler diagram, namely, one which is on the borderline of pure martensitic and martensitic-austenitic steel.

* Paper presented at the Paris Conference of the European Investment Casters Association.

FIG. 2.—*Structure of 12-per-cent. chrome steel, (left) after quenching from 1,050 deg. C. and (right) after quenching from 1,200 deg. C.*



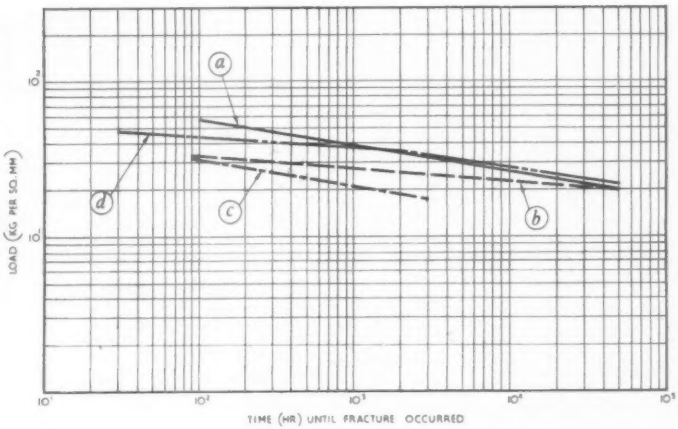


FIG. 3.—*Time-to-rupture curves for differently heat-treated chromium steels, expressed logarithmically.*

KEY: (*a*), (*b*) and (*c*) 12-per-cent. chromium steel of composition: C, 0.2; Cr, 12.5; Mo, 0.8; Co, 2.0; V, 0.5 per cent. Test temperature 550 deg. C. Specimen (*a*) tempered at 720 deg. C. after quenching from 1,100 deg. C. (57 tons per sq. in.); (*b*) tempered at 620 deg. C. after quenching from 1,100 deg. C. (70 tons per sq. in.); (*c*) quenched from 1,200 deg. C. and tempered (57 tons per sq. in.), and (*d*) commercial forging-quality steel of similar composition.

Mechanical Properties

The mechanical properties (especially the brittleness) of the complex 12-per-cent. chromium steels depend largely on their heat-treatment, and Table 1 gives their values. The quench temperatures were taken at 1,050, 1,100 and 1,200 deg. C.

TABLE 1.—*Mechanical Properties of 12-per-cent Chromium Steels.*

	Quenching temperature (deg. C.).		
	1,050	1,100	1,200
Yield point (tons per sq. in.) ..	47.6	46.3	41.9
Tensile strength (tons per sq. in.)	57.8	57.1	54.0
Reduction in area (per cent.) ..	32	46	51
Elongation (per cent.)	13	16	21
Notch impact (V8M) value (mkg. per sq. cm.)	3.3 (154)*	7 (326)	9 (419)

* The figures in parentheses are conversions to ft. lb. per sq. in.

The increase of the impact value from 3.3 to 9 mkg. per sq. cm. for a quench temperature of 1,200 is remarkable; it can be explained by an increased solution of grain-boundary carbides. The illustrations in Fig. 2 confirm this; (*a*) shows the structure of a steel quenched at 1,050 deg. C., and (*b*) the same steel quenched at 1,200 deg. C.

To obtain stable structures, heat-resistant alloys must be annealed at the highest possible temperatures. A nickel content will slow down the alpha/gamma transition, but cobalt shifts the transition temperature to a higher level. For heat-resistant alloys, part of the nickel is often substituted by cobalt to ensure the possibility of complete transition.

The 12-per-cent. chromium steels, especially when they contain cobalt, tend to brittleness at 475 deg. C., and tests were carried out on the alloy to determine this tendency. Test-pieces were kept at a temperature of 475 deg. C. for 200 and 500 hours, after which the impact values were estimated by the VSM method, the results being shown in Table 2.

For high-temperature alloys, the creep properties are of primary importance. Fig. 3 shows the time-to-rupture curves for the differently heat-treated steels. For comparison, a commercially-available steel of similar composition was subjected to the same procedure. With the exception of the steel quenched at 1,200 deg. C., the values for the other tests show little difference. It may be of interest to note that the steel annealed at 720 deg. C. is superior to that annealed at 620 deg. C. This confirms the well-known fact that low-alloy steels, annealed at high temperatures, show better time-to-rupture values at long-term (over 10,000 hr.) than the same material annealed at lower temperatures. It is pleasing for investment founders to see that castings in this material (13-per-cent. chrome steel) are the equal of the forged qualities.

TABLE 2.—*Effect of Prolonged Heating on Impact Properties.*

No. of hr. at 475 deg. C.	V8M Impact (mkg. per sq. cm.).
0	9.3
200	9.4
500	9.7

A notable example was a turbine-wheel cast in heat-resistant 12-per-cent. chromium steel, and the investigations which have been detailed in this report form part of the development work carried out for this component. The exacting working conditions (35,000 r.p.m.) of these wheels prescribe absolute freedom from any defects, such as decarbonization, inter-granular oxidation, etc.

ADA Annual General Meeting

Satisfactory progress of the Aluminium Development Association was reported by Mr. Rudolf Hahn, retiring president, when he presented his annual report at the annual general meeting of the Association, held on April 29 at 33, Grosvenor Street, London, W.1. He said that despite difficulties, such as the printing dispute, the general level of activity showed a further increase over previous years, and the high standing of the Association was acknowledged both at home and abroad. Much work had been completed on the new three-year programme initiated during the year under review. At the election of officers, Mr. W. Brining, F.C.A. who represents the Almin group of companies on the ADA Council, was elected president for 1960/61, and Mr. R. Hahn, the representative of the Association of Light Alloy Refiners and Smelters, Limited, was elected vice-president.

a

b

c

d

Notes from the Branches

Scottish

Over 50 years' ago, the Scottish branch of the Institute of British Foundrymen came into being and the opportunity was taken during the week ending Saturday, April 23, to celebrate the event. It was a convenient choice, because on that day, the Institute was holding its quarterly General Council meeting in Glasgow and the Council members and their ladies were made the guests of the branch for the Golden Jubilee functions. The first of these was a reception by the Corporation of the City of Glasgow on Friday, April 22, which was held in the imposing setting of the City Chambers. On this occasion, a total of 470 members, their ladies and a number of guests were entertained by the Corporation. The parties were received by the Lord Provost of Glasgow, Sir Myer Galpern, J.P., F.E.I.S., M.P., supported by the City magistrates, all in ceremonial robes, in the satinwood salon of the Chambers. They then passed into the banqueting hall where the Lord Provost welcomed the delegates and ladies and referred briefly to the City's long participation in foundry matters. Mr. G. R. Shotton, senior vice-president of the Institute, who represented the president, Mr. C. H. Wilson (unavoidably absent abroad) in all these events, responded on behalf of the assembly. Next, Mr. John B. McGregor, president of the Scottish branch, added his own welcome to the party and stressed the seriousness of the occasion in relation to the affairs of the branch, asking the Lord Provost to accept the thanks of the gathering for the gracious hospitality offered.

The proceedings continued in the Council Chambers with a programme of vocal music rendered in the Council Hall from 8.30 to 10.30 p.m. by the Scottish Junior Singers, conducted by Agnes Duncan with Mr. A. C. Taylor as accompanist. For those who wished to avail themselves of the opportunity, dancing to Ken MacNicol and his orchestra was available from 8.15 until "Auld Lang Syne" at 11.30 p.m. Refreshments were served throughout the proceedings in the upper corridor of the City Chambers. At the conclusion of the function, members were vocally appreciative of the opportunity which had been afforded them of attending such a noteworthy function in so historic and dignified a setting.

Celebration Dinner

The following evening, Saturday, April 23, was the occasion of a Jubilee Celebration Dinner held in the Central Hotel, Glasgow, at which the Scottish branch were hosts to a company—including ladies—of about 260. On this occasion, the representative of the Lord Provost and the City Councillors, Bailie Alexander Hart, O.B.E., was the chief guest. Mr. McGregor, branch president, was in the chair, supported by a large and distinguished top-table assembly which included the following:

Mr. G. R. Shotton; Sir A. McCance; Mr. John Scott; Mr. John Bell; Mr. D. A. Richards; Mr. A. Robertson; Mr. J. H. Andrew; Mr. James S. McMillan; Mr. G. M. Menzies; Mr. John Cameron; Mr. James Ferguson; Mr. J. W. Todd; Mr. A. Campion; Mr. J. H. Stuart; and Mr. A. Marshall (most of these gentlemen were accompanied by their ladies).

After the Loyal Toast had been honoured, the president opened the speeches by referring briefly to the reasons for the gathering and then asked Mr. A. Marshall to continue. The secretary began by outlining the branch's progress over the years attributing much of it to its enthusiastic inauguration and sponsoring by Professor A. Campion, F.R.I.C., who had piloted the branch for a long period and, at 86, was now the sole surviving founder member. He was pleased, and knew the gathering would be similarly gratified, that Professor Campion and Mrs. Campion had found themselves able to attend the Jubilee Banquet in person—a truly remarkable feature, since the branch had been established when Professor Campion was in his 36th year. On behalf of the members, he then presented Professor Campion with a wooden tobacco jar and pipe-set from the branch and afterwards called on Miss McGregor, the president's daughter, to make a presentation of a bouquet of roses to Mrs. Campion.

Professor Campion, now an honorary member of the Institute, then acknowledged the gift and said that if he had devoted so much of his life to the affairs of the branch, it was because this association had been so rewarding to him personally. The initiation of the branch had followed requests to him made by his students at the Glasgow Technical College (now Royal College of Science and Technology) and in 1910, he had conferred with friends in the Institute already established in England and the Scottish branch had resulted. It had gone from strength to strength and now he was pleased to learn that membership had passed the half-thousand mark. Mrs. Campion also made brief acknowledgment of the branch's thoughtfulness in giving her flowers, which were now one of her great enjoyments in life.

After a short interval, the proceedings recommenced with the toast to the "City and Corporation of Glasgow" proposed by Mr. Shotton, Bailie Alexander Hart, O.B.E., replying. Mr. G. Lambert, secretary of the Institute, then injected a tribute to Mr. A. Marshall, secretary, who had organized so well the whole proceedings. This was accorded with great applause and Mr. Marshall replied briefly.

The photographs reproduced on the facing page were taken during the IBF Scottish branch jubilee celebrations. At the top is a group at the Friday night's reception by the Lord Provost of Glasgow. From left to right (front row) Mr. A. Marshall, the Lady Provost, Mr. G. R. Shotton, the Lord Provost (Sir Myer Galpern), Mrs. McGregor and Mr. J. B. McGregor. In the second row are the City magistrates with, in the centre, Bailie Alexander Hart, who was chief guest at Saturday's dinner. Photograph (a) shows Sir Andrew McCance with Mr. and Mrs. G. M. Menzies (Mr. Menzies is a past-president of the British Steel Founders' Association); (b) shows Mr. J. B. McGregor (president, Scottish branch), with Mrs. McGregor and their daughter at the Saturday evening dinner (Mrs. McGregor is admiring the bouquet presented to Mrs. Campion); (c) shows Mr. G. R. Shotton (senior vice-president of the Institute) chatting informally with Bailie Hart and Mr. G. Lambert, the Institute's secretary, and (d) is of Professor A. Campion thanking the assembly on Saturday for the presentation marking his 50 years' association with the Scottish branch (Mrs. Campion is seated on his right and Mr. A. Marshall (who made the presentation) is standing on his left).

Notes from the Branches

The toast of "The Guests" was proposed by Mr. John Bell, past-president of the Institute and secretary of the Scottish branch for many years. The response in this case was made by Sir Andrew McCance, D.L., D.SC., LL.D., F.R.S., chairman, Board of Governors, Royal College of Science and Technology. It was then the task of Mr. D. A. Richards, junior vice-president of the Institute, to propose "The Scottish Branch of the Institute" and on this occasion—to conclude the formal speeches—Mr. James H. Andrew, president-elect of the branch, replied. Interspersed during the speeches was music by the Mackintosh Trio. Mr. J. Colquhoun (tenor), Mr. R. Gilmour (baritone), and Mr. J. Ritchie (conjurer) provided further light entertainment, with Mr. D. Y. Mackintosh as accompanist.

All those attending were agreed that the events formed a very fitting and dignified celebration of the branch's Jubilee, and the response had been typical of the respect with which the Institute's affairs were held in technological circles.

News in Brief

A £50,000 MEDICAL CENTRE has been opened at the Heath Street Works, Smethwick, of Guest Keen & Nettlefolds (Midlands), Limited.

OVER 250,000 yds. of cables have been supplied by British Insulated Callender's Cables, Limited, for the new British Road Services' £750,000 Tyneside depot.

THE ADDRESS of Precision Components (Barnet), Limited, is now Kabi Works, Cranborne Road, Potters Bar, Middlesex (Telephone: Potters Bar 3444).

THE GLASGOW OFFICE of the alloys division of Union Carbide, Limited, is now at Cornhill House, 144, West George Street. The telephone number, Central 6454, is unchanged.

PLANS for a £500,000 extension to Paisley Technical College have been approved by the local authority. The site will provide not only for immediate extensions but also for those that may be necessary in the future.

PLANNING PERMISSION has been granted for Colvilles, Limited, to erect a sub-station, costing £56,000, at its melting shop and to make an extension, costing £15,000, to the locomotive sheds at the Ravenscraig plant.

PROBAN, LIMITED, makers of flame-resistant finishes for fabrics, have moved from the Royal Exchange, Manchester, to larger and more commodious offices at 34, Princess Street, Manchester, 1 ('phone CEN. 8093 and 8094).

STEEL CASTINGS were among items displayed at Dronfield Parish Church on Sunday, May 1, when the annual industrial service took place. More than 20 firms contributed and their representatives attended the service.

THE 1960 TRAVEL SCHOLARSHIP offered by Stewarts and Lloyds, Limited, has been won by Mr. G. D. Day, sales representative of the Cardiff office, who is to work in a European refugee camp and otherwise play a part in World Refugee Year.

THE STORY of the development of a firm from three men and no sales, to a staff of 1,000 and sales totalling nearly £6,000,000 in 12 years, was told to the British Institute of Management Conference on April 21, by Mr. Norman Bailey, director of Dexion, Limited.

BRIGHTSIDE HEATING AND ENGINEERING COMPANY, LIMITED, Sheffield, have supplied £600,000 worth of apparatus and equipment for use in the new hospital at Ahmadi, Kuwait, on the Persian Gulf, opened last month by Sir Phillip Southwell, former chairman of the Kuwait Oil Company.

FIFTY EMPLOYEES of Land Pyrometers, Limited, Queen's Road, Sheffield, flew to Holland for a day trip on April 25 to mark the centenary of the firm. The firm paid travelling and dinner expenses as well as passport costs. The party toured the tulip fields and visited the Floriade before attending a celebration dinner.

Mr. A. M. DALLAS, a senior representative of the Surform division of Firth Cleveland Tools, Limited, a member of the Firth Cleveland group, is to have his territory extended to include County Durham and Middlesbrough. Mr. Dallas is already Surform representative for Scotland, Northern Ireland and the north of England.

A NEW FOUNDRY for the production of alloy and ductile irons is to be built in Cumbernauld (east of Glasgow), for Forth Alloys, Limited, a company controlled by Robert Taylor & Company (Ironfounders), Limited, Stirlingshire. Production is expected to commence in October next. Initially about 50 people will be employed.

THE CARNEGIE LIBRARY of Pittsburgh (4,400, Forbes Avenue, Pittsburgh, 13, Pennsylvania, USA) announces with regret that their "Review of Iron and Steel Literature for 1958" could not be printed. However, a typescript copy is available in the technology department and arrangements can be made for the purchase of photostat copies.

QUICK-READING COURSES for business executives are being held at Nottingham Technical College. With the aid of films of reading texts which are shown at gradually increasing speeds, the tutors hope to raise the average reading speed by at least 60 per cent. from 240 to nearly 400 words a minute, with some students reaching 520 words.

THE RECORD NUMBER of 7,000 tractors was exported from the United Kingdom by Massey-Ferguson (Great Britain), Limited, during the month of March. In the previous four months the company exported 18,000 units, and during the 1959 fiscal year the firm increased its exports of tractors to territories in the eastern hemisphere by 9 per cent. compared with 1958.

THE DIRECTORS of Edgar Allen & Company, Limited, Sheffield, have presented an inscribed bronze plaque, with a relief of Professor F. C. Lea, for the wall of the new materials laboratory at Sheffield University, to be known as the "F. C. Lea Laboratory." The company wish to be associated with the project because Professor Lea was a director of the firm from 1936 to 1950.

REPRESENTATIVES OF THE American Kaiser Steel Corporation and the Westinghouse group are touring Formosa to study steel production there. The Kaiser Corporation wants to build a steelworks in the Far East with a capacity of about 160,000 short tons and costing $45,000,000. The Japanese Fuji Iron & Steel Company, Limited, is also interested in building a steel plant in Formosa.

"SUBDUED IMPROVEMENT" in the flow of new orders to British shipyards, which began last December, has continued into the first quarter of this year, according to the Shipbuilding Conference. In the first quarter, UK yards received orders for 53 ships of 196,000 gross tons, compared with 69 vessels of 172,000 tons in the

last quarter of last year and with only 55,000 tons in the first three months of last year.

SHEFFIELD EDUCATION COMMITTEE has recommended the acceptance of the tender of Tersons, Limited, for the erection of the third phase of the Sheffield College of Technology for the sum of £1,178,586, subject to fluctuation in the cost of labour only. The City Architect is to make certain adjustments to the specification which will reduce the figure to bring the cost of the work involved within the amount acceptable to the Ministry of Education.

Mr. F. A. HURST, chairman of Samuel Osborn & Company, Limited, Sheffield, presented safe-driving awards at the annual dinner/dance of the firm's transport department at the Arcade Restaurant, Sheffield, on April 22. During 1959, vehicles from the Sheffield works covered 355,667 miles and carried 72,817 tons without any major trouble or accident. Mr. Sidney Charlesworth received a brooch for 15 years accident-free driving with the firm.

THE ROYAL ORDNANCE SMALL ARMS FACTORY at Fazackerley, Liverpool, is to close when current orders are completed. The Secretary for War, Mr. Christopher Soames, has announced, "The factory will begin to run down in June, and except for a small force remaining to wind up, all employees will have become redundant by about the end of the year." It is said that the Government will do all they can "to find a suitable firm to make good productive use" of the factory.

SHIPS OF ALL NATIONS have been arriving at the port of Los Angeles during the last six months with steel and steel products for the construction of houses in Southern California. A boom in the building industry has been caused by the phenomenal rise in the population of the southern half of California by 3,356,000 during the last decade—70 per cent. of the total increase in the entire State. Last year home-building permits valued at $2,840,650,000 were issued for 159,708 houses.

FOR THE PAST YEAR, employees at the Willenhall foundry of Arthur Shaw & Company, Limited, have been engaged in the evening and during their lunch-time breaks in building themselves a social club, from an R.A.F. hut which they bought for £240. The re-erection of the 80 ft. by 21 ft. hut in Bilston Street, is expected to be completed in about eight weeks' time. The cost to the employees is about £1,000: the land is being rented by them from the firm for about 6s. a year.

DERBY EDUCATION COMMITTEE has approved an expenditure of nearly £60,000 on the latest instalment of the new Derby and Derbyshire College of Technology, and a similar sum will be paid by the Derbyshire County Council who share the College. One eight-storey block is already complete and in use by students, and the second block is nearing completion. A third building is to be added, and when completed in 1966 the College will have cost over £1,000,000

CRITICISM of firms who do not call the fire brigade when fire breaks out is made by Mr. Sidney Jowett, Chief Fire Officer at Derby, in his annual report. He states, "One local firm alone in the past year had 200 fires, not one of which was reported to the fire brigade." The outbreaks were dealt with by the factory personnel, but Mr. Jowett says, "unfortunately this system will continue until eventually a small fire gets out of hand and a hurried call will be made for the assistance of the professional firemen."

THE GENERAL ELECTRIC COMPANY, LIMITED, has recently received an order for eight Sherwen electromagnetic vibrating feeders for installation in the steel-works of the Koninklijke Nederlandsche Hoogovens en Staalfabrieken N.V., Ijmuiden, Holland. This brings the total value of this type of vibrator and feeder supplied to this company to approximately £31,000. Two of the 48-in. by 6-ft. feeders already installed are each capable of handling finished sinter-ore, 25- to 200-mm. in size, at the rate of 400 tons per hour.

WHEN THE BRITISH EXHIBITION opens in New York's Coliseum on June 10, American truck operators will be able to examine, on stand 320, two British diesel trucks which have been described by an American already operating two of them as . . . combining excellent workmanship with an incredible economy of operation. The two trucks appearing on this stand of Leyland Motors (U.S.A.), Limited, will be a haulage model from the group's Chieftain range with a maximum g.v.w. of 10¾ tons, and a haulage model from the group's Clydesdale range which has a maximum g.v.w. of 14 tons.

DISCUSSIONS between the Consolidated Zinc Pty., (which is expected to build the £100,000,000 aluminium smelting scheme in Southland, New Zealand) and the New Zealand Ministry of Works were scheduled to take place at Invercargill towards the end of last month. The conference follows a series of meetings between officers of both parties in recent weeks. The talks were to make an up-to-date assessment of investigations already carried out so that the company can more easily determine the cost factors involved, particularly regarding the development of the required amount of electric power from Lake Manapouri.

A NEW BUILDING for the inspection of castings by exposure to gamma-rays at the Penistone foundry of the David Brown Foundries Division enables medium and large castings to be handled at the same time in separate compartments. Another development at Penistone is the completion of a new large gas-fired heat-treatment furnace with automatic recorders and controllers, which will enable heat-treatment at higher temperatures than at present. The firm which has gone in for manufacturing pipeline valves, is now projecting an extension into the making of complete pump units, as well as examining the question of prime movers for pumps.

THE ELECTRONIC COMPUTER, Pegasus, of the United Steel Companies, Limited, at Sheffield, and used jointly by Sheffield University, is to be enlarged at a cost of about £50,000. This will provide greatly increased capacity and make more complex calculations possible at one run. Pegasus can handle about 4,000 numbers at once at present. After extensions it will take up to about 1,000,000. The computer is housed at the Sheffield department of operational research of the group and has a big application in the structural design work of the United Steel Structural Company at Scunthorpe. The machine is expected to be operating in its advanced form in a year.

MR. ARTHUR H. THOMAS, national president of the Purchasing Officers' Association, said at the annual luncheon of the Sheffield and district branch of the Association at the Kenwood Hotel, Sheffield, on April 29, that the remarkably good relations existing between management and labour in Sheffield industry were an example to the rest of the country. He said, "This freedom from strikes, wildcat or any other type, impresses buyers more than is perhaps realised. One of the buyers' biggest headaches is the assurance of schedules, and good labour-relations is one of the main factors securing that position." He added that the possible fusion of the European Common Market and Free Trade Area with elimination of import duties should make for a very competitive atmosphere, and buyers were watching future implications with marked interest.

Personal

Mr. G. F. PRESCOTT has been appointed a director of British Resin Products, Limited, London, W.1.

Mr. A. D. C. GUNN has been appointed technical director of Cochran & Company, Annan, Limited.

Mr. BRYAN TOPLEY has been elected deputy-chairman of Albright & Wilson, Limited. He joined the company in 1936 and was appointed a director in 1944.

Mr. C. H. OFFORD, general manager of the Newhouse (Lanarkshire) factory of Honeywell Controls, Limited, has been appointed a director of the company.

Mr. J. A. METCALFE, a director of Minerals Separation, Limited, has been elected to the board of Foundry Services (Holdings) Limited, Birmingham.

Mr. ROBERT L. LICKLEY will be joining the board of Hawker Aircraft, Limited, on May 16. He resigned his managing directorship of the Fairey Aviation Company, Limited, in April when that company was absorbed into the Westland group.

Mr. W. B. CHRYSTAL has been appointed to represent Richard Baxendale & Sons, Limited, in the North of England. His territory includes Lancashire, Cheshire, Cumberland, Westmorland, Northumberland, Durham and the North Riding of Yorkshire.

Mr. L. H. POMEROY, formerly marketing manager and general sales manager for Massey-Ferguson (Australia), Limited, has been appointed director of marketing of Massey-Ferguson (United Kingdom), Limited, in place of Mr. T. V. KNOX who has resigned.

Mr. DENNIS SCORAH is the new editor of the works magazine of the Osborn organization, Sheffield, *The Hand and Heart*. He succeeds Mr. T. ALEC SEED, who has retired after 52 years' service with the company, where he has latterly been employment manager.

Mr. A. GEOFFREY BANKS has been elected president of the Engineering Centre, Birmingham, in succession to Mr. VICTOR BRENNER, who has held the office for the past four years. Mr. Brenner has been appointed vice-president and Mr. J. TREVOR JONES, honorary treasurer.

Mr. E. F. CHOPPEN has resigned from the board of the Esso Petroleum Company, Limited, following his appointment as deputy co-ordinator of the world-wide marketing operation of Standard Oil Company (New Jersey). He will shortly leave for New York to take up his duties.

Because of ill-health, Mr. F. ERIC L. BACHE has resigned as chairman of Geo. Salter & Company, Limited, spring-balance manufacturers, West Bromwich. Mr. R. PHILIP S. BACHE who succeeds him as chairman will also continue in his position of managing director. Mr. R. P. S. Bache has been a director of the company since 1928.

Mr. J. A. JACKSON, works director of Wolf Electric Tools, Limited, London, W.5, flew to Canada on May 1, on a ten days' business visit to the company's branch at Toronto. The company also announces that Mr. KLAAS VAN WALRAVEN has been appointed sales supervisor for Holland. For several years, Mr. van Walraven has been responsible for promoting electric tool sales for Warmond, Limited, Rotterdam.

The engineering group of the General Electric Company Limited, announces the appointment of Mr. E. W. MOLESWORTH as chief engineer for the London, southern and eastern areas. Mr. Molesworth, who has completed more than 30 years' service with GEC, assumed his new post on April 1. His predecessor, Mr. C. J. O. GARRARD, was recently appointed assistant general manager of the company's Erith engineering works.

To mark their retirement, five foremen who between them have given more than 230 years service to the Stanton Ironworks Company, Limited, near Nottingham, were presented with cheques and certificates at a dance organized by the Work's Foremen's Association at Stanton Club House on April 22. Three of the foremen, Mr. FRANK BARBER, Mr. JOE GLAZEBROOK and Mr. BERT TAYLOR, have worked at Stanton for 52 years. Mr. ARTHUR RAYNOR has been employed at the ironworks for 46 years, and Mr. ERNEST BAKER for 35. The presentations were made by the managing director, Mr. N. C. Macdiarmid.

Mr. P. SPEAR, director of research at Rubery Owen & Company, Limited, Darlaston, and Mr. R. MILLS, manager of the group's foundry-equipment department situated at Willenhall, are flying to America by Comet on May 7, to attend the American Foundrymen's Society Convention and Exhibition which is being held in Philadelphia next week. It is reported that they will be following up certain American interest in the Hallsworth automatic moulding system manufactured by Rubery Owen, and will study American foundry methods with an eye on suitable application of the system. They will also be seeking possible extensions to their range of equipment and the trip will afford the opportunity of doing so by first-hand contact.

Obituary

The death has occurred of Mr. ROBERT CYRIL HARGRAVES, director Hargraves Bros. (M/cr.), Limited, Quay Street, Manchester.

The death occurred recently of Mr. SIDNEY JOHN COCHRANE, a director of Cochrane & Sons, Limited, shipbuilders, of Selby (Yorks). He was 57.

Mr. FRANK DICKINSON, former chief works chemist at Holwell Ironworks near Melton Mowbray, Leics, died suddenly on April 19 at the age of 66.

The death is reported of Mr. ERNEST TALLON, a director of James Douglas & Sons, Limited, firebrick manufacturers, Stoke, and of the Diamond Clay Company, Limited, Stoke.

Mr. HAROLD WATKINSON, who formerly worked at the iron foundries of Newton Chambers and Company, Limited, Chapeltown, Sheffield, for over 50 years, has died at the age of 80.

Mr. JOSEPH FULLELOVE, a senior foreman of Newton Chambers & Company, Limited, Sheffield, has died at the age of 56. He was a founder vice-president of the work's football and sports sections and chairman of the Foremen's Association.

Mr. JAMES EASDALE, 22-year-old son of the principal of R. M. Easdale & Company, metal and scrap merchants, smelters, etc., Glasgow, in which he was a trainee, was killed in a car crash on the Glasgow/Kilmarnock road on April 26.

The death has occurred of Mr. JOSEPH STAVES, a former local director of Thos. W. Ward, Limited, Albion Works, Sheffield, at the age of 71. Mr. Staves, who retired a year ago after being with the company for 56 years, had held the positions of chief assistant accountant and of chief accountant, and was made a local director in 1938.

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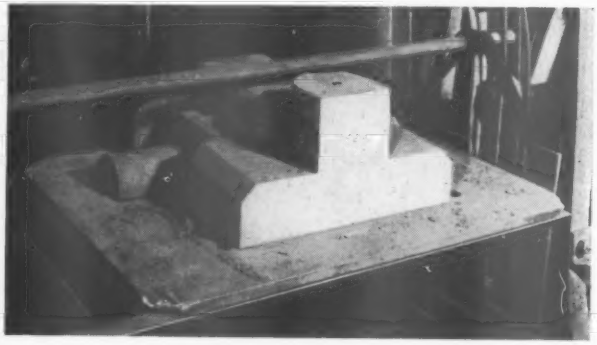

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Raw Material Markets

Iron and Steel

The increased demand for certain grades of pig-iron is being met satisfactorily. There is an exceptionally heavy demand for basic steelmaking pig-iron, reducing considerably the stocks at furnaces and absorbing the capacity-level outputs. In some areas supplies are inadequate, but deliveries from home sources largely relieve this deficiency. With record ingot outputs, the steelworks are using all available supplies and dependence for their production is mainly on pig-iron supplies because of the scarcity of suitable scrap.

At the ironfoundries, the chief call is still from the engineering and speciality foundries for low phosphorus pig-irons and hematite. The former is their main choice, and substantial tonnages are being supplied together with good quantities of hematite and some refined irons. These foundries cover their needs of all these irons for both current and forward bookings. In most brands of low phosphorus irons now available, producers can dispose fully of their makes, and this also applies to hematite pig-iron for which there is an increasing demand from foundries and steelworks.

Production of high quality castings by the engineering and speciality foundries is maintained at high levels with the motor vehicle industry the most prominent customer. Only the shortage of suitable labour prevents an improvement on these high outputs. Other users of high-duty castings are also taking up substantial tonnages including the steelworks, power and electrical plant manufacturers, machine-tool, and heavy engineering trades, but collieries and railways show little improvement in demand.

The call for builders' castings is maintained, and steady demands are also forthcoming from the domestic appliance trades. The light foundries supplying to them are fairly well employed, but more orders are needed to keep the mechanized plants at capacity. Jobbing and textile foundries are steadily employed, although not at capacity. The high phosphorus pig-iron used by these foundries is in good supply and furnaces can easily meet demands. After these demands are fulfilled, spare tonnages from stock and current outputs are shipped to overseas buyers.

Continuous demands are being made by the ironfoundries for suitable cast iron and steel scrap. There is a ready demand, not fully satisfied, for the better and heavier grades. Foundry coke deliveries are satisfactory and requirements of ganister, limestone, and firebricks are easily obtainable.

The re-rollers continue busy and are working at capacity. Demands for all their products are good and regular orders for small bars, light sections, and reinforcing rods continue to be received. Although home steelworks continue to supply them with substantial tonnages of steel semis, deliveries are inadequate, and there is a shortage of 2-in. billets. Arisings at the steelworks of suitable re-rolling quality defectives and crops are readily accepted by the re-rollers.

Non-ferrous Metals

The jump in stocks of refined copper held in London Metal Exchange official warehouses last week to 2,649 tons was the prime factor influencing the market earlier this week. The increase was more than was expected and made for more settled conditions after previous fluctuations.

The outlook is conditioned by whether more copper will be made available in London or whether the Chilean strike will extend to the whole industry, dislocate supplies, and cause a severe shortage. In the US market conditions are still only fair and the quotation of 33 cents a pound is applicable to both producers and custom smelters.

The feature of the tin market has been the assumed disappearance of the buffer stock manager, which resulted in the price of tin rising very close to the Tin Council's " ceiling " of £800 a ton. However, prices came down as quickly as they had gone up, but it is not yet certain whether this is due to a reappearance of the buffer stock manager or to an increase in supplies from elsewhere. In any event, the market is nervous and the backwardation, which had been as wide as £12 a ton last week has now narrowed to around £4 a ton. In the US the market is quiet and the price is fairly steady fractionally below 99 cents a pound.

Lead in London has experienced mixed trading conditions. On balance, prices have held fairly steady around £77 a ton. In the US the market is quiet and the quotation for New York spot is given as 12 cents a pound.

Zinc has been more sensitive than usual and fluctuations have been relatively wide. However, demand is still satisfactory and the price is holding fairly firm around £99 a ton. In the US the market is quiet and the quotation for East St. Louis spot is given at 13 cents a pound.

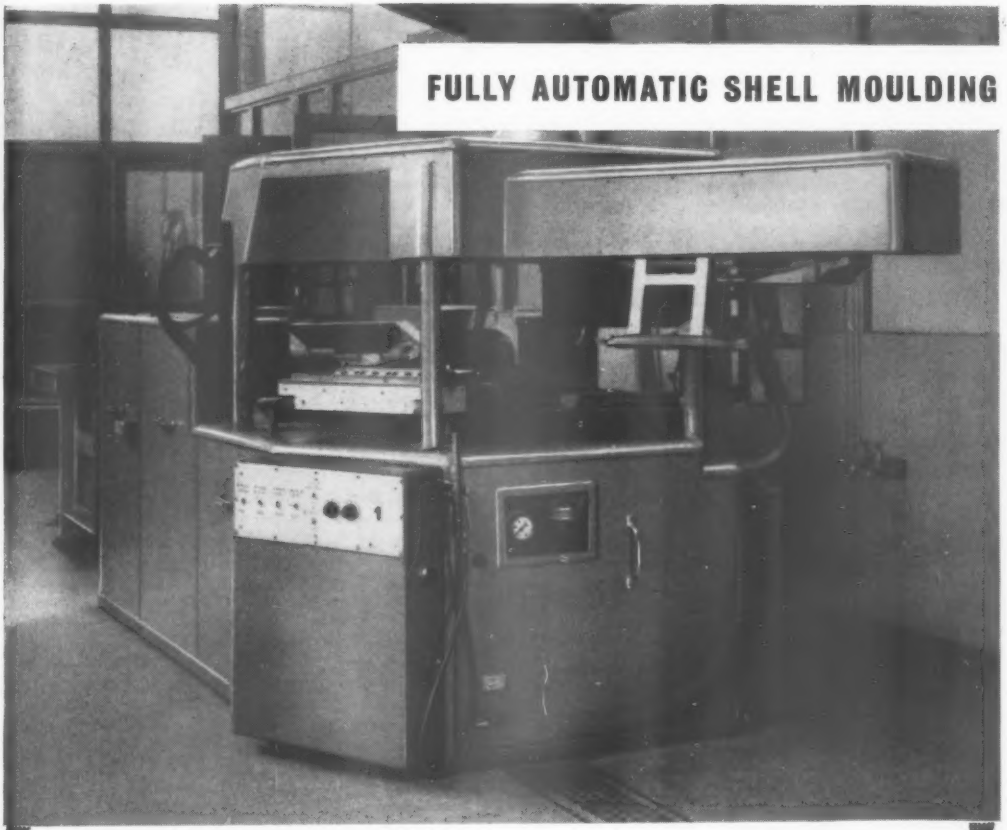
" ECSC Production Rise will slow down "

Production rise of 7.3 per cent. last year in the European Coal and Steel Community had probably continued during the first quarter of this year, said M. Roger Reynaud, member of the ECSC High Authority, in a report to the community's consultative committee. He said that industrial production may rise less swiftly in the second quarter because of the slower rate of growth in the building and foodstuffs industries.

Mr. Reynaud described the steel situation as " fundamentally sound." Consumption continued at a high level even though stockbuilding continued (although at a lower rate) and export orders dropped as a result of the rapid recovery of US production. Because of marked delivery delays of certain products, the community's steel industry would have to use all available capacity during the second quarter of the year. Supplies of raw materials provided no significant difficulties.

The coal situation remained disturbing despite some increase in demand, reported M. Reynaud. Total consumption was likely to be up by 5 per cent. during the second quarter of the year in comparison with a year ago. Demand from coking plant would probably rise by 9 per cent.; from power stations by 10 per cent.; and from domestic users by 4 per cent. Despite competition from other sources, demand from other industrial users would be maintained.

M. Reynaud recalled that in February the High Authority had given a reasoned refusal to the request for a single sales agency for Ruhr coal. Since then, the Authority had discussed the matter with the Federal German Government, producers, and other interested parties. It had decided that the old selling system due to have expired on March 31, would be prolonged until June 30. Should it prove impossible to find a formula ensuring healthy market conditions and in conformity with the Treaty, there remained the possibility of a revision of the Treaty, M. Reynaud added.



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BP/F5

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

May 4, 1960

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2, 10-ton lots or over: Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.40 per cent. P, 10-ton lots or over, £23 5s. 0d., delivered Birmingham, £23 10s. 0d., delivered Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 6s. 6d.; South Zone, £25 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.; North Zone, £26 6s. 6d.; South Zone, £26 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent., 10-ton lots or over: N.-E. of England (local iron), £23 19s. 0d.; Scotland (Scotch iron), Zone S.1, £24 5s. 6d.; Sheffield, £25 7s. 6d.; Birmingham, £25 14s. 0d.; Wales (Welsh iron), £23 19s. 0d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leicestershire in 10-ton lots or over.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £41 10s. 0d. to £44 0s. 0d., scale 15s. 0d. per unit, lumpy; 75 per cent. Si, £57 0s. 0d. to £62 10s. 0d., scale 15s. 0d. per unit, lumpy.

Ferro-vanadium.—50/60 per cent., 22s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 10d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £287 0s. 0d.

Ferro-tungsten.—80/85 per cent., 11s. 8d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 14s. 8d. per lb. of W.

Ferro-chrome (6-ton lots and over, lumpy).—4/6 per cent. C, £78 10s. 0d. to £82 10s. 0d., basis 60 per cent. Cr. scale 26s. 0d. to 28s. 6d. per unit; over 6 per cent. C, £77 0s. 0d. to £80 10s. 0d., basis 60 per cent. Cr, scale, 26s. 0d. to 28s. 6d. per unit; 2 per cent. C,* 1s. 8d. to 1s. 11d. per lb. Cr; 1 per cent, C,* 1s. 8½d. to 1s. 11½d. per lb. Cr; 0.15 per cent. C,* 1s. 9½d. to 2s. 0½d. per lb. Cr; 0.10 per cent C,* 1s. 9¾d. to 2s. 0¾d. per lb. Cr; 0.06 per cent. C,* 1s. 10½d. to 2s. 1d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 10d. per lb.

Metallic Manganese.—94/96 per cent., carbon-free, £275 0s. 0d.; 9 6/98 per cent., £285 0s. 0d.

Ferro-columbium.—65/67 per cent., Cb + Ta, 19s. 9d. per lb., Cb + Ta.

Ferro-manganese (Standard).—78 per cent., £63 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft u.t., 100 tons & over, £31 15s. 6d.; tested, 0.08 to 0.33 per cent. C, 6 to 35 tons, £33 15s. 6d.; hard (0.41 to 0.60 per cent. C), under 10 tons, £34 17s. 0d.; silico-manganese, under 10 tons, £43 16s. 6d.; free-cutting, under 10 tons, £36 14s. 6d. SIEMENS MARTIN ACID (under 10 tons): Up to 0.25 per cent. C, £41 1s. 0d.; silico-manganese, £44 4s. 0d.

Billets, Blooms, and Slabs for Forging and for Stamping (under 10 tons).—Basic, soft, up to 0.33 per cent. C, £38 10s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 12s. 6d.; acid, up to 0.25 per cent. C, £43 4s. 0d.

* Average 68–70 per cent.

FINISHED STEEL

Heavy Plates and Sections (1 ton to 10 tons).—Ship plates (N.-E. Coast), £41 12s. 0d.; boiler plates (N.-E. Coast), £44 2s. 0d.; floor plates (N.-E. Coast), £43 10s. 0d.; angles (N.-E. Coast), £38 16s. 6d.; joists (N.-E. Coast), £38 12s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats 5 in. wide and under, untested soft basic, 50 tons and over, £39 1s. 0d.; under 10 tons to 4 tons, £40 18s. 0d.; under 4 tons to 2 tons, £41 3s. 0d.; hoop and strip, coils, 100 tons and over, £38 0s. 0d.; uncoated strip mill coils, hot rolled, under 3 mm. to 12g., 25 tons to under 50 tons, £43 16s. 0d.; black sheets (hand mill), 24g., 10 tons and over. £57 14s. 6d.; galvanized corrugated sheets, 24g., 10 tons and over, £68 5s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £67 17s. 0d.; nickel-chrome, £98 11s. 0d.; nickel-chrome-molybdenum £111 4s. 0d., in lots of 5 tons to under 10 tons.

NON-FERROUS METALS

Copper.—Cash, £263 0s. 0d. to £264 0s. 0d.; three months, £249 0s. 0d. to £249 10s. 0d.; settlement, £264 0s. 0d.

Copper, Tubes, etc.—Solid-drawn tubes, 2s. 6d. per lb.; rods, 275s. 6d. per cwt. basis; 20 s.w.g., 310s. 6d. per cwt.

Tin.—Cash, £791 0s. 0d. to £792 0s. 0d.; three months, £787 0s. 0d. to £788 0s. 0d.; settlement, £792 0s. 0d.

Lead (Refined Pig).—First half May, £77 2s. 6d. to £77 5s. 0d.; first half August, £76 5s. 0d. to £76 7s. 6d.

Zinc.—First half May, £94 0s. 0d. to £94 2s. 6d.; first half August, £91 15s. 0d. to £92 0s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £127 15s. 0d.; rolled zinc (boiler plates), all English destinations, £125 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £105 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 0¾d. per lb.; sheets to 10 w.g., 225s. 6d. per cwt.; wire, 2s. 10¾d.; rolled metal, 225s. 6d. per cwt.

Brass (Brazing).—BS1400, B3, £172; B6, £227.

Brass (High Tensile).—BS1400, HTB1, £202; HTB2, £223; HTB3, £237.

Gunmetal.—BS1400, LG2, £217; LG3, £227; G1, ½%, £284; G1, 1%, £271.

Phosphor Bronze.—BS1400, PB1 (AID released), £318; BS1400, 90/10/1, £305.

Leaded Phosphor Bronze.—BS1400, LPB1, £237.

Phosphor Bronze Strip, etc.—Strip, 317s. 9d. per cwt.; wire, 4s. 4d. per lb.; rods, 3s. 6¾d.; tubes, 3s. 6¾d.; chill cast bars, solids 3s. 6¼d.; cored 3s. 7¼d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 0¾d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 5¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 4¾d. All prices are net.

Other Metals.—Magnesium, ingots 2s. 2¼d. to 2s. 3d. per lb. Antimony, English, 99 per cent., £190 0s. 0d. Quicksilver, ex-warehouse, £70 10s. 0d. to £71 0s. 0d. Nickel, £600 0s. 0d. Aluminium, ingots, £186 0s. 0d.; aluminium bronze (BS1400), AB1, £262; AB2, £270.

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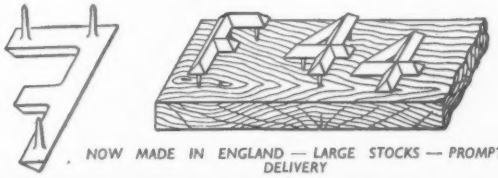

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Company News

NEWMAN INDUSTRIES, LIMITED, electrical and mechanical engineers, of Bristol—The dividend for 1959 is raised from 10 to 12½ per cent.

ANTI-ATTRITION METAL COMPANY, LIMITED—Group net loss for 1959 was £92,033 (£11,137). The chairman, Mr. H. Wilmot, states that the company is now making profits.

LILLESHALL COMPANY, LIMITED, structural engineers, etc., of Oakengates (Salop)—No dividend on ordinary for 1959 (7½ per cent. less tax), but capital distribution of 1½d. per 2s. share, not subject to tax.

JOHN DALE, LIMITED, non-ferrous castings, etc., of London, N.11—Net profit after taxation was £189,714 (£69,685). The chairman, Mr. Robert Carr, says that the forward position appears satisfactory.

LAURENCE SCOTT & ELECTROMOTORS, LIMITED—The dividend is raised from the equivalent of 12½ per cent. to 15 per cent. on a capital increased by a one-for-six scrip issue, with a 10 per cent. final for 1959.

VICKERS, LIMITED—Sales in 1959 were £155,540,000 (£176,850,000) and the net profit dropped to £4,930,000 (£6,590,000). The final dividend is maintained at 7½ per cent., making the annual total 10 per cent. for the fifth successive year.

R. W. CRABTREE & SONS, LIMITED, engineers, printing-machine manufacturers, etc., of Leeds—The company has the largest order-book ever, and the prospect of a still further expansion in orders is a "very live one," states the chairman, Mr. C. H. Crabtree.

TUBE INVESTMENTS, LIMITED—Dividend is raised from 7½ per cent. to 8½ per cent. on £16,800,000 capital for the year ending July 31, 1960. A final dividend of not less than 8¾ per cent. has been forecast on the capital doubled to £33,600,000 by the recent rights issue.

CHARLES ROBERTS & COMPANY, LIMITED, rail and road vehicle manufacturers, etc., of Wakefield—As a result of further consideration of the possibilities of a merger with the Birmingham Railway Carriage & Wagon Company, Limited, the board has decided to abandon negotiations.

HALESOWEN STEEL COMPANY, LIMITED—The board expects to pay an interim ordinary dividend of 4 per cent. in September. This compares with 4 per cent. paid prior to a one-for-five scrip issue. Mr. C. S. Burch, the chairman, says that the situation for the remainder of 1960 seems "set fair."

HOPKINSONS, LIMITED, bronze, iron, and steel founders, engineers, etc., of Huddersfield—The final dividend is raised to 15 (10) per cent., making 22½ (17½) per cent. for the year to January 31, 1960. Group profits increased to £1,095,923 (£913,848) and the net balance is up from £456,598 to a record £575,423.

CRAVEN BROS. (MANCHESTER), LIMITED, makers of iron castings, machine tools, etc., of Stockport (Ches)—Net profit for 1959 was £148,543 (£126,111), after tax of £110,000 (£107,000). One-for-one scrip issue is proposed by capitalising £700,000 of reserves. A final dividend of 10 per cent. makes 15 (10) per cent. for the year.

MAYOR & COULSON, LIMITED, mining-equipment manufacturers, of Glasgow—Group net profit fell from £365,435 to £162,032 in 1959, after tax of £106,753 (£314,479). The dividend is maintained at 10½d. per 10s. share, with a final of 6d. per share on the capital increased by the shares issued against the acquisition of Austin Hoy & Company (Holdings), Limited.

CAMMELL LAIRD & COMPANY, LIMITED—Group operating surplus fell sharply from £1,388,464 to £571,557 in 1959 and the net profit of the parent is £575,541, compared with £171,826 in 1958 when £671,375 was retained by subsidiaries. The dividend is reduced to 7 (15) per cent., but with the 4 per cent. final there is a special payment of 2½ per cent. tax free.

ASSOCIATED ELECTRICAL INDUSTRIES, LIMITED—Lord Chandos, the chairman states, "The demand for our products has shown a notable increase and we are budgeting for increased profits on our ordinary trading accounts." Marginal profits were expected in 1960 in cables where the turnround from profits to losses had made an adverse difference of £1,400,000 to trading results.

COCHRAN & COMPANY ANNAN, LIMITED, engineers and boilermakers—The interim at 2 per cent., tax free, on account of the year ending June 30, 1960, is maintained and the directors state that profits for this year will be lower. Though it is not possible to forecast the exact results for the year, it is hoped that the final will be not less than 5 per cent., tax free, making 7 per cent. net for the year against 9 per cent. previously.

PRESSED STEEL COMPANY, LIMITED—The rights issue comprises 7,151,013 ordinary 5s. shares to be offered at 30s. each to ordinary shareholders and holders of 5½ per cent. convertible debenture stock, 1977-82, registered on April 19. Ordinary holders will be offered two new shares for every 25s. ordinary capital now held, and holders of convertible debenture stock will be offered 66 new shares for every £125 of stock held.

METAL CLOSURES, LIMITED, of West Bromwich (Staffs)—The dividend is raised 24 per cent. (21¾ per cent. equivalent) and scrip issue and share consolidation proposals will result in a holder of an existing 4s. share becoming a holder of two shares of 5s. It is proposed to issue £1,000,000 debenture stock to implement the policy of equipping factories with the most up-to-date plant. Group profit, before tax, was £831,685 (£413,388, excluding John Dale, Limited, acquired during 1959).

Iron-ore Imports

Imports of iron ore and concentrates (except chrome iron ore and roasted iron pyrites) in March, and the totals for the first three months of this year and last, are shown in the table below.

From	Month ended Mar. 31.	Three months ended March 31.	
	1960.	1959.	1960.
	Tons.	Tons.	Tons.
Sierra Leone	64,340	149,724	207,550
Canada	—	102,040	223,405
Other Commonwealth countries and Eire	1,050	3,300	6,275
Sweden	442,549	687,103	1,182,610
Norway	18,848	93,862	77,153
France	68,686	100,932	161,829
Portugal	9,498	42,297	74,156
Spain	86,245	120,324	215,857
Algeria	269,601	462,064	594,434
French West Africa	—	74,026	—
Tunisia	77,180	190,406	198,427
Morocco (excluding Tangier)	50,525	119,566	188,767
Liberia	77,350	99,540	152,570
Venezuela	125,576	375,461	427,797
Brazil	41,737	132,980	151,270
Other foreign countries	65,583	30,400	183,184
TOTAL	1,398,768	2,784,025	4,045,284

GKN plan £6,750,000 Expansion

To raise production of ingots to 1,000,000 tons per year, the Guest Keen Iron & Steel Company, Limited, propose to spend £6,750,000 on an expansion programme for its East Moors Works at Cardiff. The plan has been approved by the Iron and Steel Board and the expenditure will be financed from group resources. Since 1946 the company has spent some £13,000,000 on the works, and during this period production capacity has increased from around 500,000 tons to 750,000 tons of ingot steel per year.

At present three out of four blast-furnaces are being operated to yield 610,000 tons of iron annually. Alterations to the plant will enable the fourth furnace to be blown simultaneously with the other three, to give some 875,000 tons of iron a year. Production in the melting shop will be increased to 1,000,000 ingot tons a year by the extensive use of oxygen in the open-hearth furnaces, and the use of a larger ingot. Included in the development is the latest type of fume-extraction plant, costing about £300,000, by which emission of smoke and dust will be controlled. In the mills, extra rolling stands are to be installed to enable the production of billets to be increased, and for ancillary services there will be a new mould-assembly and ingot-stripping shop. The company at present employs about 5,000 people at Cardiff, and will require additional employees by 1963 when the scheme is to be completed.

Swedish Steel Plant Plans in India

A licence to build a factory at Poona, about 150 miles east of Bombay, has been granted to Sandvik Steel Works, Sandviken, Sweden. Both tungsten-carbide bits and finished products will be produced, and the total investment in land, buildings, and machines is estimated at £550,000.

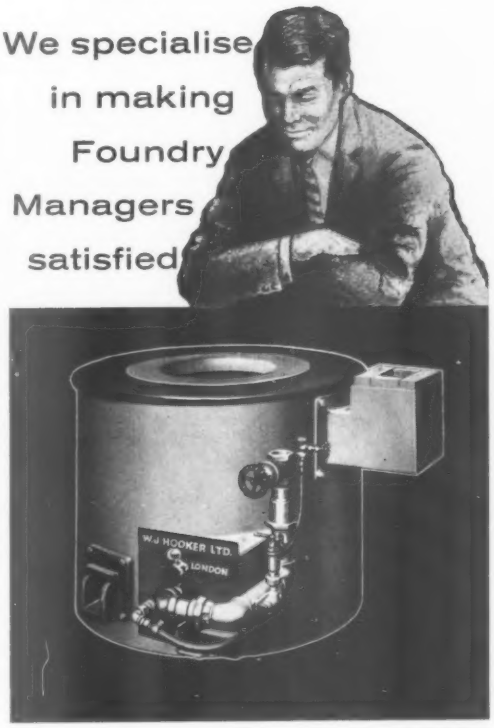
An Indian company, Sandvik Asia, Limited, will be formed to take charge of planned production, and Mr. Dharamsey M. Khatau, a well-known Indian industrialist, will be a member of its board. The project will be financed by Swedish and Indian capital, it is stated.

Production will start next year. Initially the factory will be under the leadership of Swedish engineers who will introduce Swedish production methods. A staff of Indian technicians will be trained gradually.

End-1959 Spurt in Industrial Stocks

Stockbuilding by industry gathered momentum in the final quarter of 1959, according to the Board of Trade Journal. Stocks rose by £58,000,000 during the period, but the increase was smaller than previously estimated. Manufacturers' stocks rose by £68,000,000 and the main gain in this category was among the engineering industries which added £54,000,000 to their stocks.

During the whole year, manufacturers' stocks rose by about £103,000,000. The value of work in progress increased by £97,000,000 and of materials and fuel by £24,000,000, but stocks of finished goods were reduced by £17,000,000. Wholesalers' stocks in the final quarter fell by £16,000,000 and this figure also represents the fall over the whole year. Retail stocks rose by £6,000,000 in the final quarter, to make a total advance of £45,000,000 for the whole year.



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New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s. 6d.)

813,518. Foundry Services, Limited, Long Acre, Nechells, Birmingham, 7, and John Knowles (Wooden Box), Limited, Woodville, near Burton-on-Trent.

Improvements in tiles or similar exothermic/refractory articles used for lining the head box of an ingot-casting mould. (See also Patent nos. 627,678 and 769,719, FOUNDRY TRADE JOURNAL, April 25, 1957; 774,490/1 and 785,984, JOURNAL, February 20, 1958, and 805,823, JOURNAL, April 16, 1959.)

813,772. Rolls-Royce, Limited, Nightingale Road, Derby.

The inventors claim a method of manufacturing moulds or cores from a refractory material, for investment-casting purposes. The material used is moistened with an aqueous solution of sodium or potassium silicate. This is then hardened by the action of carbon dioxide. At least one thermosetting resin (a composition comprising benzene styrene (monomer), with an unsaturated polyester resin, a catalyst and an accelerator) is used.

813,900. Mo Och Domsjo A.B., Ornskoldsvik, Sweden. Sulphomethylcelluloses (cellulose ethers) which can be used as a core-binder and a core adhesive.

813,914. Foundry Services, Limited, Long Acre, Nechells, Birmingham.

Gas hardenable core-moulds and the like which have improved collapsibility and can be used satisfactorily even with low-melting-point metals. The base used in the production of these cores comprises moulding sand, sodium silicate, and has a breakdown additive, carbon, having an average particle size not greater than 50 microns.

814,410. Gebr. Bohler and Company, A.G., Vienna, Austria.

It is claimed in this invention that the intake of hydrogen, thereby avoiding the formation of flakes, in the molten steel during continuous casting can be controlled by covering or deflecting surfaces, and by suction devices over the after-cooling section of the billet, so as to isolate or draw off the vapours of the cooling agent from the molten liquid metal.

Increases in Capital

GURNARD ENGINEERING, LIMITED, Derby, increased by £19,900, in £1 shares, beyond the registered capital of £100.

MINE & RAIL EQUIPMENT, LIMITED, Nottingham, increased by £900, in £1 ordinary shares, beyond the registered capital of £100.

MOSS GEAR COMPANY, LIMITED, Birmingham, increased by £500,000, in 5s. shares, beyond the registered capital of £1,150,000.

METAL CLOSURES, LIMITED, London, W.1, increased by £665,000, in 4s. ordinary shares, beyond the registered capital of £1,000,000.

FRY'S DIECASTINGS, LIMITED, London, S.W.19, increased by £100,000, in £1 ordinary shares, beyond the registered capital of £500,000.

METAL AGENCIES COMPANY, LIMITED, Bristol, increased by £500,000, in 5s. ordinary shares, beyond the registered capital of £1,000,000.

ARCHIBALD JOHNSTONE (ENGINEERS), LIMITED, Leeds, increased by £92,500, in £1 ordinary shares, beyond the registered capital of £7,500.

LEWDEN METAL PRODUCTS, LIMITED, London, W.1, increased by £50,000 in £1 ordinary shares, beyond the registered capital of £25,000.

MORGAN COMPONENTS, LIMITED, Stanmore (Middx), increased by £150,000, in £1 ordinary shares, beyond the registered capital of £50,000.

House Organs

NMIA News: The National and Midland Ironfounders' Association has recently issued its first quarterly bulletin under this title. It reviews, very briefly, a number of current topics of interest to members and some new publications which concern ironfounding; by so doing, it performs a very useful service. Included in this first issue, *inter alia*, are a list of new British Standards, notes on the occurrence of pneumoconiosis in iron foundries, the main points raised at the Council meeting of the Council of Ironfoundry Associations last October, and a series of reviews of booklets such as "Safety in the use of Abrasive Wheels," "Budgetary Control" and "Joint Consultation in Practice."

Malleable Iron Facts No. 62. Issued by the Malleable Founders Society, Union Commerce Building, Cleveland, 14, Ohio, USA.

In this issue, it is stated that this year Detroit will need 590,000 tons of malleable castings (2,000 tons every working day) as components for the motor-car industry. It is estimated that the 1960 compact cars will contain an average of 80 lb. of malleable, whilst Chrysler's new "Valiant" will require approximately 1 cwt.

"Broomwade" News Bulletin, Vol. 23, No. 1. Published by Broom & Wade, Limited, High Wycombe, Bucks.

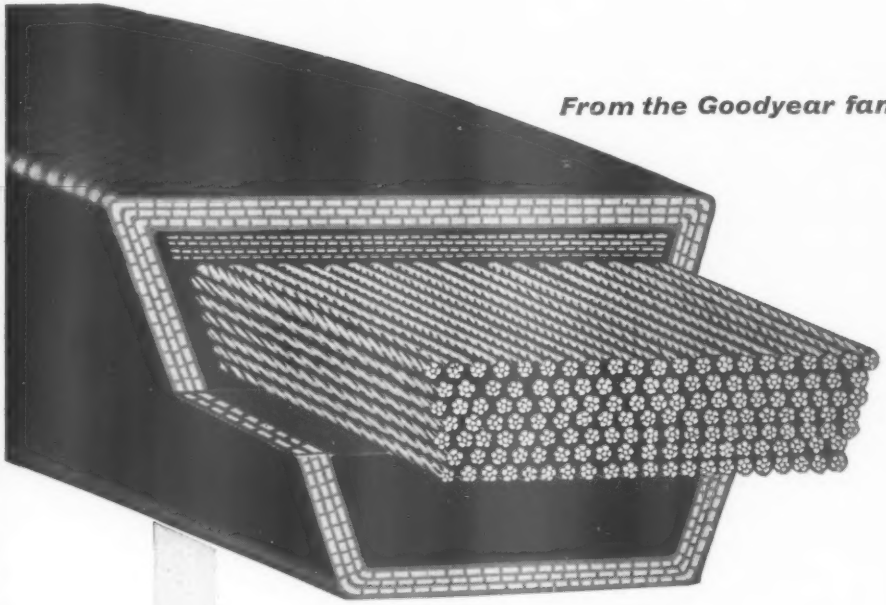
This issue prints a testimonial from a Danish foundry —the Faaborg Iron Foundry Engineering Works— expressing satisfaction with the performance of a 12-year-old D22A compressor and referring to it as a "veteran." However, another article in this issue details the history of a compressor installed in a brewery in 1915 which is still in continual use.

New Catalogues

Core Oils. In publication S.P. 189/061, Fletcher Miller, Limited, Alma Mills, Hyde, Cheshire, have made excellent use of three-colour printing to illustrate cores made from their core oil "Almarine." Among advantages claimed for the core oil are that by its use baking time is reduced, less gas is produced, high dry-strengths are obtained and knock-out is easy. The pictures of the cores shown in the brochure are of very high quality.

Surface-roughness Tester. In publication No. 4367/1, Philips Electrical, Limited, Century House, Shaftesbury Avenue, London, W.C.2, describe and illustrate an instrument for measuring the surface roughness of machined components, but the instrument no doubt could be adapted to give a sound appreciation of the surface of a casting. A hand-operated probe (only 2-in. long by approximately ¼-in. sq.) is passed over the surface, the result being shown on a meter.

Fans. In publication No. F 5701, Air Control Installations, Limited, Ruislip, have covered their standard range of fans, and indicate that special features can be incorporated in the fans to meet customers' requirements. The brochure runs to 12 pages and is well illustrated, much of the data being presented through the medium of graphs.



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American Letter

Statistical Survey

Recently published foundry statistics for the US indicate that, in 1959, steel and malleable producers increased production by approximately 33 per cent., with s.-g. iron rising even more by nearly 50 per cent. Grey iron, aluminium and copper improved 20 per cent. on their 1958 rate, and zinc by 10 per cent. Magnesium production, however, stayed at the same level. The improvement during 1959 was almost undoubtedly due in a large measure to the slump in 1958, and the outlook for 1960 is not measuring up so far to the high hopes held at the beginning of the year. It is, however, too early as yet to predict a recession right down to the 1958 level, and the current hope is that the 1959 rate will be sustained throughout this Presidential Election year.

The following figures summarize foundry activities during the years 1957 to 1959 (all figures are in English tons × 1,000):

Total Castings Production in the US

	Grey iron.	Steel.	Malleable.
1944	8,730	2,172	784
1949	9,870	1,125	645
1954	1,030	1,057	735
1959	1,102	1,262	795

Ferrous Castings Deliveries

	Grey-iron castings deliveries.		Steel castings deliveries.			Malleable-iron castings deliveries.		
	Total.	Spheroidal-graphite iron.	Total.	Carbon.	Alloy.	Total.	Regular.	Pearlitic.
1957 ..	11,300	53.5	1,575	1,186	390	770	637	134
1958 ..	9,260	105.2	1,002	715	285	590	482	107
1959 ..	11,010	149.0	1,263	930	325	794	654	167

Pig-iron and Scrap Totals

	Foundry pig-iron production.	Pig-iron consumption (by furnace).			Iron and steel scrap consumption.	
		Cupola.	Air.	Electric.	Cupola.	Air.
1957	2,043	3,720	194	220	8,240	917
1958	1,448	2,970	151	206	6,900	732
1959	1,200	—	—	—	7,830	944

Light-alloy Figures

	Copper-base castings.				Aluminium castings.				Magnesium castings.	Zinc-base castings.
	Total.	Sand.	Permanent mould.	Ingot metal.	Total.	Sand.	Permanent mould.	Die.	Total.	Total.
1957	390	353	20	222	335	64	104	167	13.5	299
1958	340	310	14	204	286	56	100	129	12.9	263
1959	402	353	24	246	350	64	121	165	12.2	294

AEI (Manchester) wins Industrial Safety Award

The Sir George Earle Trophy for industrial safety achievement has been awarded this year to Associated Electrical Industries (Manchester), Limited (formerly Metropolitan-Vickers Electrical Company, Limited), "in recognition of very many years of outstandingly successful efforts to produce a safe place of work for its large number of employees through training, both general and specific, given to all branches of personnel; by the meticulous guarding of hazardous plant and machinery, and in recognition of the generosity of the company in making its help and advice readily available to others in the interests of accident prevention."

The company's frequency rate for reportable accidents has shown a continuous downward trend. During the 12 years it has fallen from 1.13 to 0.46. Presentation of the trophy will take place at the society's National Industrial Safety Conference at Scarborough on May 27.

Simon-Carves wins Three New Contracts

Three important contracts have just been won by Simon-Carves, Limited. The first, awarded by the Steel Company of Wales, Limited, is for gas-cleaning plant on two 400-ton open-hearth furnaces to be installed at Port Talbot. The contract is stated to include provision of equipment for dust conveying and disposal.

The South Durham Steel & Iron Company, Limited, has awarded the company a contract for fume-removal and gas-cleaning plant for a hot-slab scarfing machine, to form part of the new plate mill being installed at South Works, West Hartlepool. The plant comprises an electro-precipitator, gas-storage vessel, interconnecting ducts, fan and stack.

A contract for a further sulphuric-acid plant with a daily capacity of more than 200 tons has been ordered by W. & H. M. Goulding, Limited. The plant will be in the Dublin area and is expected to be ready by the summer of next year.

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APB1

Pig-iron and Steel Production

Statistical Summary of February Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table 1 summarizes activities during recent months. Table 2 gives production of steel ingots and castings in February. Table 3, weekly average production of finished steel in January. Table 4 gives the production of pig-iron and ferro-alloys in February, and furnaces in blast. (All figures are weekly averages in thousands of tons).

TABLE 1.—*Iron and Steel Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index, 1938 = 100.			Iron-ore output.	Imported ore used.	Coke sent to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy).			
	Iron and steel.	Coal.	Basic materials[1]						Imports.[2]	Prod. ingots, castings.	Delivrs. finished steel	Stocks.[3]
1957	328	488	537	325	303	270	275	220	14	417	322	2,580
1958	343	403	478	276	262	227	245	196	9	369	284	2,242
1959	340	497	477	286	244	210	242	208	7	388	291	2,244
1960—Feb. ..	338	501	487	333	320	256	302	250	15	482	374	2,260

TABLE 2.—*Average Weekly Production of Steel Ingots and Castings in February.*

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derbys., Leics., Notts., Northants. and Essex ..	—	4.8	16.8 (basic)	2.7	0.1	22.9	1.5	24.4
Lancs. (excl. N.-W. Coast), Denbighs., Flints., and Ches.	1.0	39.6	—	5.5	0.3	44.9	1.5	46.4
Yorkshire (excl. N.-E. Coast and Sheffield) ..								
Lincs.	—	53.1	—	—	0.1	53.1	0.1	53.2
North-East Coast	0.8	92.3	—	1.5	0.4	93.1	1.9	95.0
Scotland	1.5	49.3	—	3.7	—	52.3	2.2	54.5
Staffs., Shrops., Worcs., and Warwicks.	—	23.0	—	4.4	0.8	26.3	1.9	28.2
S. Wales and Monmouthshire	2.0	93.1	16.9 (basic)	0.9	0.1	112.6	0.4	113.0
Sheffield (incl. small tonnage in Manchester) ..	8.8	36.9	—	14.7	0.4	58.6	2.2	60.8
North-West Coast	—	—	5.8 (acid)	0.9	—	6.6	0.1	6.7
Total	14.1	392.1	39.5	34.3	2.2	470.4	11.8	482.2
January, 1960	12.6	386.6	37.9	32.1	2.2	460.2	11.2	471.4
February, 1959	11.9	288.3	22.2	23.0	2.0	337.7	9.7	347.4

TABLE 3.—*Deliveries of New Non-alloy and Alloy Finished Steel*

Product.	1958.	1959.	1959.		1960.
			Jan.	Dec.*	Jan.
Non-alloy steel:					
Ingots, blooms, billets, and slabs[4]	4.6	5.1	5.2	5.1	5.6
Heavy rails ..	10.2	0.8	6.6	6.9	6.9
Sleepers	1.2	0.6	0.6	0.2	0.5
Fish- and sole-plates	0.7	0.4	0.5	0.4	0.4
Plates:	47.3	43.1	41.8	44.8	49.2
Other heavy prods.	41.8	41.2	33.4	46.8	54.7
Ferro-concrete bars	7.6	9.6	6.4	10.0	12.1
Wire rod	21.5	23.5	20.9	25.5	29.4
Arches, etc. ..	8.6	7.8	8.6	6.4	7.7
Other light sections	29.1	33.0	30.6	38.9	42.0
Bright steel bars ..	6.2	7.6	6.8	8.5	9.7
Hot-rolled strip ..	22.6	27.4	24.9	28.7	34.9
Cold-rolled strip ..	7.0	8.0	7.1	8.9	10.0
Sheets, incl. coated:					
(i) Hot rolled ..	10.6	11.8	10.3	12.1	12.4
(ii) Cold reduced	31.1	35.2	33.5	34.8	39.8
Tinplate:	18.7	20.9	21.8	22.3	22.7
Blackplate ..	0.8	0.7	0.8	0.7	0.7
Tubes up to 16 in.	19.0	20.6	19.4	22.1	25.7
Tube fittings, etc.	0.4	0.4	0.4	0.4	0.4
Tyres, wheels, axles	4.5	2.4	3.3	2.0	2.7
Forgings (excl. drop)	2.6	2.1	2.5	1.9	2.1
Steel castings ..	4.2	3.6	3.6	3.7	4.2
Tool steel, etc. ..	0.2	0.2	0.2	0.2	0.3
Total	300.5	312.0	289.2	333.3	374.1
Alloy steel	16.1	18.2	16.2	19.5	23.0
Total deliveries from UK production[5] ..	316.6	330.2	305.4	352.8	397.1
Add: Imported finished steel ..	7.0	7.1	3.9	8.1	12.1
	323.6	337.3	309.3	360.9	409.2
Deduct: Intra-industry conversion[6] ..	41.2	47.6	44.2	49.2	57.1
Total new material ..	282.4	289.7	265.1	311.7	352.1

TABLE 4.—*Production of Pig-iron and Ferro-alloys*

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derbys, Leics, Notts, Northants, and Essex	19	—	26.2	23.4	—	—	49.6
Lancs (excl. N.-W. Coast), Denbighs, Flints, and Ches ..	7	—	21.5	—	—	0.8	22.3
Yorks (excl. N.-E. Coast and Sheffield)	—	—	—	—	—	—	—
Lincs	10	—	46.5	—	—	—	46.5
North-East Coast	16	2.1	63.4	—	—	—	65.5
Scotland	6	0.7	19.5	1.2	—	—	21.4
Staffs, Shrops, Worcs, and Warwicks ..	4	—	7.9	1.0	—	—	8.9
S. Wales and Monmouthshire	11	2.4	60.4	1.2	—	—	64.0
Sheffield	2	—	3.6	—	—	—	3.6
North-West Coast	8	16.5	—	1.9	—	1.3	19.7
Total ..	83	21.7	249.0	28.7	—	2.1	301.5
January, 1960 ..	81	22.1	246.6	26.3	0.3	2.2	297.5
February, 1959 ..	81	20.4	179.0	19.0	0.3	3.1	221.8

[1] Used in non-food manufacturing industries.

[2] Weekly average of calendar month.

[3] Stocks, mainly ingots and semi-finished, at the end of the year and months shown.

[4] Other than for conversion into any other form of finished steel listed.

[5] Includes finished steel produced in the UK from imported ingots and semi-finished steel.

[6] Material for conversion into other products also listed in this table.

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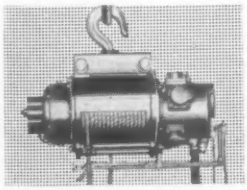

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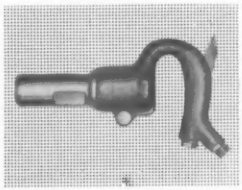

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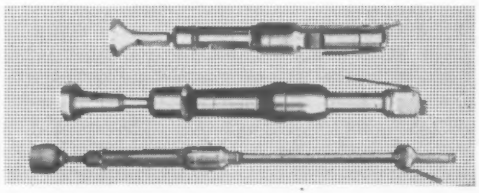

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PREPAID RATES: Fifteen words for 7/6 (minimum charge) and 4d. per word thereafter. Box Numbers 2/6 extra (including postage of replies). Situations wanted 2d. per word throughout.

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SITUATIONS VACANT—*contd.*

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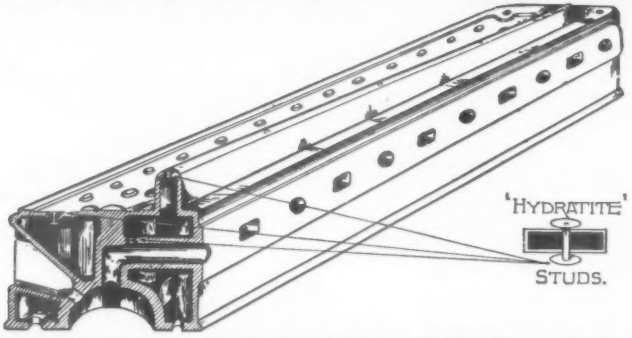

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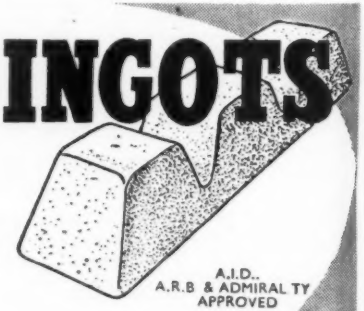

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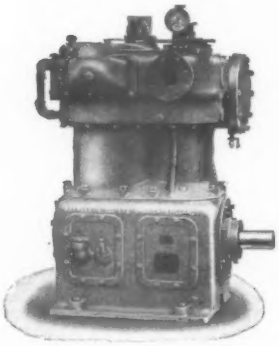

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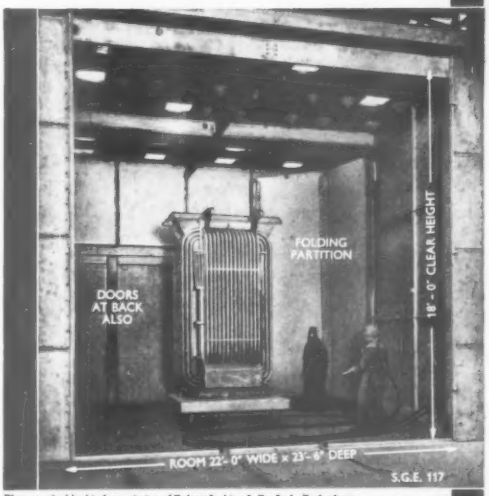

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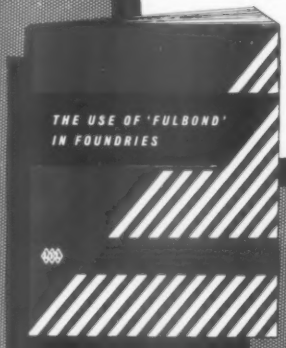

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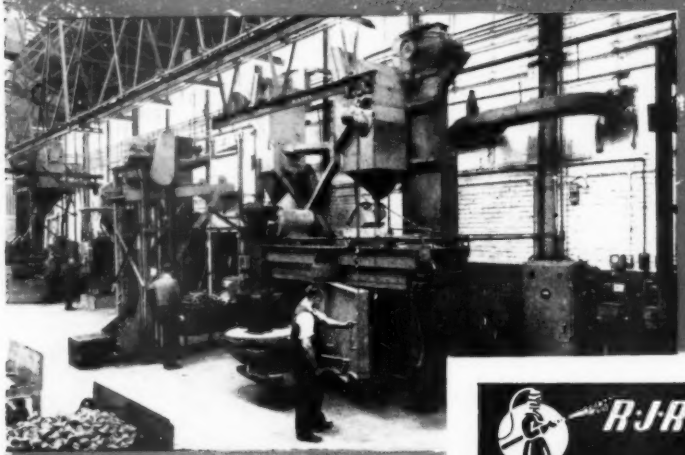

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